D 71683

elektor

up-to-date electronics for lab and leisure

104
December 1983
85 p.
IR 130p. (incl. VAT)
$ 2.75

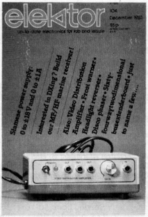
Siamese power supply: 0 to ±18 V and 0 to ±1A

Interested in DXing? Build our MF/HF marine receiver!

Also: Video Distribution Amplifier • Frost warner • Headlight reverser • Disco phaser • Sixty-fourwaytwodimensional busextenderboard • just to name a few....

AIR-MAIL COPY

contents



Our graphical department seem to have got into the 'Christmas spirit' cabinet a bit early this year, but at least they managed to get the picture of our video distribution amplifier straight. This is also in keeping with the seasonal cheer that is likely to be abundant at this time as it can have you seeing not **double** *but* **treble.** *And what about a* **two-dimensional** *bus board, or a* **Siamese** *power supply! As you may gather from this, it is not only the graphical department who have been at the 'Christmas spirit' a bit early!*

A selection from next month's issue:

- universal active filter
- digital cassette recording
- how accurate is your watch?
- wind direction indicator
- address decoding
- fault finding in audio equipment
- EPROM programmer

HOME LIGHTING KITS

These kits contain all necessary components and full instructions & are designed to replace a standard wall switch and control up to 300w. of lighting.

TDR300K	Remote Control Dimmer	£14.30
MK6	Transmitter for above	£ 4.20
TD300K	Touchdimmer	£ 7.00
TS300K	Touchswitch	£7.00
TDE/K	Extension kit for 2-way switching for TD300K	£ 2.50

ELECTRONIC LOCK KIT XK101

This KIT contains a purpose designed lock IC, 10-way keyboard, PCBs and all components to construct a Digital Lock, requiring a 4-key sequence to open and providing over 5000 different combinations. The open sequence may be easily changed by means of a pre-wired plug. Size: 7 x 6 x 3 cms. Supply: 5V to 15 V d.c. at 40uA. Ouput: 750mA max. Hundreds of uses for doors and garages, car anti-theft device, electronic equipment, etc. Will drive most relays direct. Full instructions supplied.

ONLY £10.50

Electric lock mechanism for use with latch locks and above kit £13.50

"OPEN-SESAME"

The XK103 is a general purpose infra-red transmitter/receiver with one momentary (normally open) relay contact and two latched transistor outputs. Designed primarily for controlling motorised garage doors and two auxilliary outputs for drive/garage lights at a range of up to 40 ft. The unit also has numerous applications in the home for switching lights, TV, closing curtains, etc. Ideal for aged or disabled persons.
The Kit comprises a mains powered receiver, a four button transmitter, complete with pre-drilled box, requiring a 9V battery and one opto-isolated solid state switch kit for inter-facing the receiver to mains appliances. As with all our kits, full instructions are supplied.

ONLY £23.75

Have you got our

FREE GREEN CATALOGUE yet?

NO?! Send S.A.E. 6" - 9" TODAY!!
It's packed with details of all our KITS plus large range of SEMICONDUCTORS including CMOS, LS TTL, linear, microprocessors and memories, full range of LEDs, capacitors, resistors, hardware, relays, switches etc. We also stock VERO and Antex products as well as books from Texas Instruments, Babani and Elektor.

ALL AT VERY COMPETITIVE PRICES.
ORDERING IS EVEN EASIER — JUST RING THE NUMBER YOU CAN'T FORGET FOR PRICES YOU CAN'T RESIST.

5-6-7 8-9-10

and give us your Access or Barclaycard No. or write enclosing cheque or postal order. Official orders accepted from schools, etc.

Answering service evngs & wnds

CHRISTMAS PRESENTS GALORE

3-NOTE DOOR CHIME
Based on the SAB0600 IC the kit is supplied with all components, including loudspeaker, printed circuit board, a pre-drilled box (95 x 71 x 35 mm) and full instructions. Requires only a PP3 9 V battery and push-switch to complete.
AN IDEAL PROJECT FOR BEGINNERS
Order as XK102 £5.00

LIGHT DIMMER KIT
Contains all components, including front panel and knob, to make a dimmer for lights up to 300W.
£3.50

MW RADIO KIT
Based on ZN414 IC, kit includes PCB, wound aerial and crystal earpiece and all components to make a sensitive miniature radio. Size: 5.5 x 2.7 x 2 cms. Requires PP3 9V battery. IDEAL FOR BEGINNERS.
£5.00

LCD 3½ DIGIT MULTIMETER
16 ranges including DC voltage (200 mv-1000 v) and AC voltage, DC current (200 mA-10 A) and resistance (0-2 M) + NPN & PNP transistor gain and diode check. Input impedance 10M. Size 155x88x31 mm. Requires PP3 9v battery. Test leads included **ONLY £29.00**

BEGINNERS STARTER PACKS

Containing selection of electronic components including transistors, LEDs, diodes, capacitors, ICs etc. together with a descriptive booklet with 10 easy-to-build projects plus a **solderless** circuit board enabling the components to be **re-used**. Requires 9V battery.
Discreet component pack (no ICs) £5.00   Integrated circuit pack £6.00

STOCKING FILLERS All full spec. branded devices.

PACK (1)	650 Resistors 47 ohm to 10Mohm — 10 per value £4.00
PACK (2)	40 x 16V Electrolytic Capacitors 10µF to 1000µF — 5 per value £3.25
PACK (3)	60 Polyester Capacitors 0.01 to 1µF/250V — 5 per value £5.55
PACK (4)	45 Sub-miniature Presets 100 ohm to 1 Mohm — 5 per value £2.90
PACK (5)	30 Low Profile IC Sockets 8, 14, and 16 pin — 10 of each £2.40
PACK (6)	25 Red LEDs (5mm dia.) £1.25

DISCO LIGHTING KITS

DL 1000K
This value for money kit features a bi-directional sequence, speed of sequence and frequency of direction change, being variable by means of potentiometers and incorporates a master dimming control. **£14.60**

DLZ1000K
A lower cost version of the above, featuring undirectional channel sequence with speed variable by means of a pre-set pot. Outputs switched only at mains zero crossing points to reduce radio interference to a minimum. **£8.00**

Optional opto input DLA1
Allowing audio ("beat") — light response. **60p**

DL3000K
This 3 channel sound to light kit features zero voltage switching, automatic level control and built in mic. No connections to speaker or amp required. No knobs to adjust — simply connect to mains supply and lamps. (1Kw channel) **Only £11.95**

HOME CONTROL CENTRE

This kit enables you to control up to 16 different appliances anywhere in the house from the comfort of your armchair. The transmitter injects coded pulses into the mains which are decoded by receiver modules connected to the same mains supply and used to switch on the appliance addressed. The transmitter also includes a COMPUTER interface so you can programme your favourite micro (eg. ZX81) to switch lights, heating, electric blanket, make your morning coffee, etc., automatically without rewiring your house. **JUST THINK OF THE POSSIBILITIES.** The kit includes all PCBs and components for one transmitter and two receivers, plus a pre-drilled box for the transmitter.

Order as XK112. £42.00

Additional Receivers XK111 £10.00

REMOTE CONTROL KITS

FOR A DETAILED BOOKLET ON REMOTE CONTROL — send 30p + 6" × 9" S.A.E.

MK6 SIMPLE INFRA RED TRANSMITTER
Supplied with hand-held plastic box. Requires 9V (PP3) battery £4.20

MK7 INFRA RED RECEIVER
Mains powered with triac output to switch up to 500W at 240V ac. Range approx. 20 ft. on/off or momentary control. £9.00
(RC 500K — special price for MK6/MK7 £12.50)

MK9 4-WAY KEYBOARD
For use with MK 18/MK 12 transmitter receiver where only 4 channels are required £1.90

MK10 16-WAY KEYBOARD £5.40

MK11 10 channel + 3 analogue o/p receiver
A mains powered LR receiver providing control signals to 10 on/off and 3 analogue circuits. May be used for controlling the volume of an amplifier, brightness of a lamp, etc. £12.00

MK12 16-CHANNEL LR RECEIVER
A mains powered LR Receiver providing up to 16 outputs for switching £11.95

MK18 based on the SL490. This kit includes all components to make a coded transmitter. Requires a PP3 battery and keyboard (MK9, MK10 or MK13) size 8 × 2 × 1.3cm Range approx. 60 ft £6.20

MK13 11 way keyboard for use with MK18 and MK11 kits £4.35

NOW OPEN COMPUTER SHOWROOM

Hours: Mon-Fri 10am - 6pm Sat 10am - 4pm

Jupiter ACE — DRAGON 32 — BBC MODEL B — ORIC-1 — SPECTRUM

We also stock peripherals and accessories - disc drives, printers, joy sticks etc. together with a wide range of books and the latest software for all the above computers including ZX81.

SEND S.A.E. FOR LIST TODAY!

ALL PRICES EXCLUDE VAT

MICROPROCESSOR CONTROLLED MULTI-PURPOSE TIMER

Now you can run your central heating, lighting, hi-fi system and lots more with just one programmable timer. At your selection it is designed to control four mains outputs independently, switching on and off at pre-set times over a 7 day cycle, e.g. to control your central heating (including different switching times for weekends), just connect it to your system programme and set it and forget it—the clock will do the rest.

FEATURES INCLUDE:-

* 7mm LED 12 hour display
* Day of week, am pm and output status indicators
* 4 open collector outputs for driving relays, triacs, etc
* 50/60Hz mains operation
* Battery backup saves stored programmes and continues time keeping during power failures. (Battery not supplied)
* Display blanking during power failure to conserve battery power
* 18 programme time sets
* Powerful 'Everyday' function enabling output to switch every day but use only one time set
* Useful 'sleep' function — turns on output for one hour
* Direct switch control enabling output to be turned on immediately or after a specified time interval
* 20 function keypad for programme entry
* Programme verification at the touch of a button
* Plastic box with attractive screen printed front panel 15 × 10 × 5.5cm

Now only **£39.00**

(Kit includes all components, PCB, box, assembly and programming instructions)
Order as CT6000

XK114 OPTIONAL RELAY KIT
Kit includes one relay, PCB to accommodate up to four relays, terminal blocks, etc., to fit inside CT6000 box. Provides up to four 3amp 240V AC changeover contacts

£3.90

Additional relays £1.65 each

PE LOGIC TUTOR

A complete kit of top quality components including PCB, connectors, sockets and switches and transformer. **£21.00**
PCB only £4.95

24 HOUR CLOCK/ APPLIANCE TIMER KIT

Switches any appliance up to 1kW on and off at preset times once per day. Kit contains: AY-5-1230 IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triacs, PCBs and full instructions.

CT1000K Basic Kit £14.90
CT1000K with white box (56/131 × 71mm) £17.40
(Ready Built) £22.50

DVM/ULTRA SENSITIVE THERMOMETER KIT

This new design is based on the ICL7126 (a lower power version of the ICL7106 chip) and a 3½ digit liquid crystal display. This kit will form the basis of a digital multimeter (only a few additional resistors and switches are required—details supplied), or a sensitive digital thermometer (−50°C to +150°C) reading to 0.1°C. The basic kit has a sensitivity of 200mV for a full scale reading, automatic polarity indication and an ultra low power requirement—giving a 2 year typical battery life from a standard 9V PP3 when used 8 hours a day, 7 days a week.

Price £15.50

Add 65p postage & packing + 15% VAT to total Overseas Customers;
Add £2.50 (Europe), £6.00 (elsewhere) for p&p.
Send S.A.E. for further STOCK DETAILS.
Goods by return subject to availability.

OPEN 9am to 5pm (Mon to Fri) 10am to 4pm (Sat)

FAST SERVICE · TOP QUALITY · LOW LOW PRICES

No circuit is complete without a call to —

TK ELECTRONICS

11-13 Boston Road
London W7 3SJ

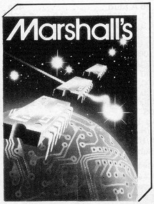
ACCESS and BARCLAYCARD welcome

TEL: 01-567 8910 ORDERS
01-579 9794 ENQUIRIES
01-579 2842 TECHNICAL AFTER 3PM

Marshall's

A. MARSHALL (LONDON) LTD

A. Marshall (London) Ltd.
Electronic Component Distributors
85 WEST REGENT STREET
GLASGOW G2 2AW
TELEPHONE: 041 332 4133



1984 CATALOGUE NOW OUT!

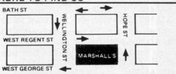
THE NEW MARSHALL'S 1984 CATALOGUE is now available – one of the biggest and best catalogues ever produced by MARSHALL'S.

56 pages crammed from cover to cover with components, accessories and testgear.

New products include I.D.C. Plugs & Sockets, 'D' Plugs & Sockets, DIL Headers, Ribbon Cable, Kits, Toroidal Transformers, I.C.'s, Capacitors, Test Probes, and lots more – something for everyone.

TRADE, EXPORT, RETAIL AND MAIL ORDER SUPPLIED.

75p to callers, £1.00 post paid – Europe, £1.50 rest of the world.

WHERE TO FIND US	CALL IN AND SEE US	MAIL ORDER	TELEPHONE
	9-5.30 MON TO FRI 9-5.00 SAT EXPRESS MAIL ORDERS ACCESS/BARCLAYCARDS WELCOME SAME DAY SERVICE	WE REGRET WE CANNOT ANSWER MAIL ORDER/ STOCK ENQUIRIES WITHOUT AN S.A.E. SAME DAY SERVICE TRADE AND EXPORT ENQUIRIES WELCOME	MAIL ORDER 041-332-4133 SHOP AND STOCK ENQUIRIES 041-332-4133 TELEX 261507 REF. 2194

Junior–Paperware

(in 2 vols.)

The floppy disk is probably the most significant mass storage medium for microcomputers. It seems incredible that so much data can be stored on a simple plastic disk at such speed and with such precision.
Unfortunately, it is not enough to just connect a floppy disk drive to a microcomputer. Without software the hardware is useless! Where can you get all the necessary source listings, hex-dumps, and EPROM modifications? In the Elektor Junior paperware, of course!
Junior paperware 1 contains the modifications of the PM/PME EPROM and the source listings and hex-dump of the software cruncher and puncher; Junior paperware 2 gives the source listing of the bootstrap loader for Ohio Scientific Floppys and the hex-dump of the EPROM.

Elektor
Publishers Ltd
Canterbury

Price £2.00 + 50p postage & packing per volume (outside U.K. £1.00).
To order, please use the prepaid order card at the end of this issue.

TWO GREAT HOBBIES ... IN ONE GREAT KIT!

The K5000 Metal Detector Kit combines the challenge of DIY electronics assembly with the reward and excitement of discovering Britain's buried past.

As a Metal Detector–the K5000 boasts the proven pedigree of C-Scope, Europe's leading detector manufacturer.
As a Kit–simplified assembly techniques require little technical knowledge, and no complex electronic test equipment. All stages of assembly are covered in a finely-detailed 36 page manual.

Detector Features Analytical Discrimination & Ground Exclusion

Ask at your local Hobby/Electronics shop or use the coupon and send with your remittance to:-
C-Scope International Ltd., PO Box 36, Ashford, Kent TN23 2LN

Please send me ...... K5000 Kits @ £119.99(+£3.00 p+p) each.

☐ Please debit my Barclaycard/Access
☐ I enclose Cheque/PO £

Name ....

Address Elk12

selektor

Universal logic: more potential in the chip

Most silicon chips are cheap because they embody conventional circuits of the sort generally needed in electronic equipment and are mass-produced. Many others are needed for special applications, but making small batches of chips designed to do specific, less common-place jobs is complicated and expensive. A new approach to this problem, based on what is called universal logic, is a design for a chip with the potential of virtually any kind of computer-logic circuit and which can be used as a 'universal' building block in electronic systems.

A new and highly original line of development in microelectronics was pioneered by Dr Stanley Hurst, a senior lecturer in the school of electrical engineering at the University of Bath, in the West of England some time ago.

Microprocessors, computer control processors on tiny slivers of silicon, are cheap and plentiful; but they are so only because of immense sales. The range available from the world's manufacturers is relatively inflexible, which means that users have to surround the microprocessor with other integrated-circuit devices to get the operation they require. So there is already a market, one which will increase in the mid 1980s and onwards, where makers of equipment need *specific* digital microelectronics devices designed to their individual needs. The difficulty here is that the cost of designing a silicon-chip device is enormous, involving many highly-skilled scientists and engineers over a very long time, even with computer-aided design, and needing very complex and expensive equipment. This huge cost is quickly recovered when there are large, world-wide sales; but such a project cannot be considered by an equipment manufacturer who needs but one or at most a few types of special digital devices designed for his particular application.

Dr Hurst is not the only one to see this. Indeed, one British firm has already won a Queen's Award for technology for what it calls its uncommitted logic array, based on blocks of conventional circuits already incorporated in each chip but not connected to each other until the customer's needs are known.

Dr Hurst's approach is quite different. Though, as he says, there has been and will continue to be tremendous development in design and manufacturing techniques, there has not been much 'evolution or revolution at the fundamental level'. If there were a general-purpose basic design, needing only the final masking procedure for arranging the interconnecting links to make a device to suit a specific purpose, the small-quantity market could be satisfied economically. So he has researched what the calls his Universal Logic.

In this context, logic is the application of Boolean algebra to a digital process using binary arithmetic. Boole was an English logician and mathematician who wrote a paper on the mathematical analysis of deductive reasoning in 1847, a paper rediscovered in 1938 and applied first to relays and switches. It was seized on in the mid-1940s for electronic computing. A computer and any similar digital device is an immense multiplicity of electronic switches, known as 'gates', which pass on binary information (that is, a 0 for 'off' and a 1 for 'on') from one or more input signals.

Table 1

Inputs		All possible output functions f (x_i, x_j)															
x_i	x_j	f_0	f_1	f_2	f_3	f_4	f_5	f_6	f_7	f_8	f_9	f_{10}	f_{11}	f_{12}	f_{13}	f_{14}	f_{15}
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
0	1	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1	0	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Functions which can be obtained from various gates with two inputs. For three input variables there are 256 possible output functions.

Lacking Power

From the evidence of digital computing it must be agreed that standard gates have been very successful, but analytically they do not satisfy Dr Hurst. In his words, they lack logical power. It is easy to see that there is an ambiguity in each gate. With an AND gate, for example, accepting inputs A and B, we can say that when one input is in the off state and the other in the on state the output is 0, but it does not indicate which one of A and B is off or on. With three input things are even more ambiguous. To put it another way, the output of NOR gate is unity only when all inputs are 0, and of a NAND gate only when all inputs are 1.

The practical outcome of this lack of logical power is that quite a number of gates have to be combined to give a specified result. For example, in one simple device adding numbers there are 16 gates. A straightforward decoder (which translates from binary to ordinary decimal numbers, among other tasks) needs 50 gates to do its basic job. A circuit to compare one number with another has 33 gates. (These figures are taken from a random look at some published circuits.) In a microprocessor there may be at least 3000 gates.

The inefficient way orthodox gates operate Boolean logic has set more than one microelectronics engineer or scientist thinking of possible better circuits. But large manufacturers have had such enormous success in getting thousands of gates on a silicon chip, making it a cheap device, that they are interested only in competitive technological improvements in getting more and more on less and less. There is no reason why they should be interested in fundamental changes in logic. In the market for small-quantity, custom-built chips things are different.

Mathematical

The approach of Dr Hurst and his colleagues is fundamental yet unconventional. In trying to find out whether one could get a basic circuit that would do whatever logical step was needed, according to the connections and the programming, their thinking was primarily mathematical: it made use of esoteric techniques such as set theory, Walsh functions and so on. They were able to show that a universal logic gate was indeed a possibility. With two input variables there are 16 possible output functions (see table 1, which is an exercise to see what functions could be obtained from various gates). For three input variables there are 256 possible output functions. Could a single circuit cope?

Calling the circuits ULG2 (universal-logic gate for two input variables) and ULG3, Dr Hurst has shown that an array of ULG2 gates will do all the logical steps possible even for three input variables and that one ULG3 will be capable of realising all

1

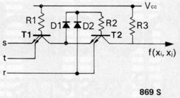


Figure 1. Basic circuit of a ULG2, comprising two transistors, two diodes and three resistors. Although only two input variables are applied, three input connections (s, t and r) are provided. This is to do with the set-theory mathematics of the device.

256 outputs — not all at once, of course, for the result depends on which input terminals are used and how the circuit internal wiring is connected.
The number of ULG2 cells needed to realise all the 256 functions of three input variables has been calculated and compared with the equivalent figure for orthodox gates. The results are shown in table 2.
We can see that the ULG2 is roughly twice as powerful as a NAND or a NOR. Incidentally, it should be noted that although a ULG2 may have only two independent variables as input, there may be three or four physical connections. Figure 1 shows a circuit for a ULG2. It has two transistors, two diodes, and three resistors. Though there are but two input variables, there are three input connections. This is to do with the set-theory mathematics of the device and need not concern us.
The circuit shown brings in electronics, which has so far not been discussed and need not be considered in detail. A gate is made of transistors, diodes, resistors and, sometimes, capacitors. Up to now most logic gates have depended on bipolar technology, that is, transistors with two possible states. This is the one represented in the diagram. A newer technique is based on MOS (metal-oxide-semiconductor) devices, which involve far fewer stages in manufacture and avoid the 'cross-talk' between adjacent conductors. Dr Hurst considers that bipolar methods will die out in the next decade and be replaced by MOS circuitry.
The practical problem is concerned with how big an area of silicon is used up in a ULG as compared with orthodox gates. It is easily seen that a ULG3 would occupy much more space. So is it better to use an array of identical ULG2s or rely on a ULG3? When such matters are decided there will be available a set of universal-logic gates which can be supplied as units. All that the designer then has to do is produce a suitable mask, a task made simple by computer-aided design, which will deposit the appropriate interconnections on the chip. The cost of design for a custom-made device will therefore be drastically reduced, even if the ULGs are themselves more expensive than orthodox gates — another question being researched. Furthermore, as Dr Hurst has said, a considerable amount of special logic design in ULG form can be undertaken and a library of standard interconnection details built up, ready for individual customer requirements. It is a long-term research development programme for which full-time staff will be recruited. It could lead to a commanding position in the ever-growing use of silicon chips for specific purposes.

C.L. Boltz SPECTRUM 171

Table 2.

	ULG2	NAND	NOR
Total number of cells or gates to realise all 256 functions	683	1118	1124
Average number per function	2.67	4.36	4.39
Maximum number per function	4	7	7
Average number of cell/gate connections per function	10.68	17.44	17.56

Comparison between the capabilities of ULG2 cells and that of orthodox gates. The table shows that the ULG2 is roughly twice as powerful as a NAND or a NOR gate.

Taking the heat out of electronics

Air cooling was traditionally used to cool electronic units but as component densities are continually increased in new designs of equipment so the problem of cooling has grown to the point where liquid cooling is having to be adopted. This is because of its ability to offer higher heat removal rates.
However, liquid cooling has brought its own constraints because its pipework, pumps and fluids make it much more difficult for service engineers to get to the electronic components.
Now the dynamics group of British Aerospace claims to have solved the problems with what it describes as a 'new concept' in liquid cooling systems. Known as Flexiwall, the BAe system is subject to a provisional patent application and, at an international design engineering exhibition recently held at Birmingham in the English Midlands, has been chosen as a good example of British innovation.
A BAe spokesman said: 'The major benefit of Flexiwall is that uninterrupted access can be obtained to electronic units for servicing or replacement without the need to drain or disconnect the cooling system, which is entirely separate and self-contained. Other attributes are that it is a low-pressure system, silent in operation, and is inexpensive to manufacture and install. In terms of volume occupied by a Flexiwall system, it is significantly more effective in removing a given quantity of heat than air cooling systems of comparable capacity.
Tests with a prototype system have shown that an electronic unit containing a large number of components tightly packed together and dissipating four kilowatts of heat can be maintained at component temperatures below 70 degrees C.
This is achieved by circulating a cooling fluid such as water glycol through a convoluted chamber which expands like a bellows to allow a flexible face to move forward until it touches the electronics equipment. It will then mould itself to the shape of the component and the cooling fluid rapidly removes heat being conducted from inside the electronics unit. When the pressure on the cooling fluid is switched off the Flexiwall face retracts elastically clear of the equipment being cooled.
This ability to retract when not being used to cool the unit means that components can be freely removed from their racks for servicing or replacement. When maintenance work is completed the Flexiwall system is simply switched on and the stainless steel foil face of the cooling chamber advances to regain contact.
Made in Britain/John. F. Webb

(895 S)

The first time a microprocessor bus system is used it seems enormous, but before long it begins to seem a bit limited, and then cramped, and finally completely inadequate. So after our first bus with 3 connectors, and the second with 5, we now introduce the new extension bus with no less than 7 connectors, which, unlike its predecessors, is perfectly symmetrical.

64-way bus board

and service aid in µP systems

a new two-dimensional extension bus with 7 + 2 connectors

The new Elektor universal bus differs from its predecessors in that it has seven 64-way female connectors, plus a male connector at one end (the 'input') and a female connector at the other end (the 'output'). In addition to this, its upper side (connector side) is copper-clad and acts as a screen. The layout of the board also allows easy interconnection between lines.

An extension for testing

As can be seen from figure 2, the bus board is in eurocard format. This is neither luck nor simply the consequence of the number of connectors used. It was, in fact, a deliberate choice to allow us to use the new board as a service aid. Imagine a micro computer constructed of eurocard-format boards mounted on a bus board that is hidden somewhere at the back of a 19 inch rack. What happens if one of these cards has to be tested and repaired? Without removing everything from the case the cards are inaccessible.

This is where the new bus comes in. The extension board can be plugged in in place of the suspect one which is, in turn, plugged into the female connector on the bus board. This leaves the board to be tested completely outside the case of the computer and thus perfectly accessible. Obviously this makes childs play of something that would otherwise be quite difficult. This method of using the extension bus to counter the problems of testing in tight spaces can also serve as an aid for checking signals on the bus itself, with an oscilloscope or logic analyer for example.

576 pins to solder

As we have already said there are 64 lines and there is no interconnection between any pin in an 'a' row and a neighbouring 'c' pin. At least, that is the idea. Careless soldering could inadvertently change this. Bear in mind that the vertical (1 . . . 7) connectors are polarized and therefore must be mounted the right way round. Connector 0 (the input) is a male right angle connector (note that the 'a' and 'c' rows are inter-

Parts list

- Seven 64-way straight female connectors (a + c rows), DIN 41612
- One 64-way right-angled male connector (a + c rows), DIN 41612
- One 64-way right-angled female connector (a + b or a + c rows) DIN 41612
- Two metal brackets (for mounting connector no. 8)
- Mounting hardware and ideally guide rails

1

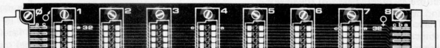
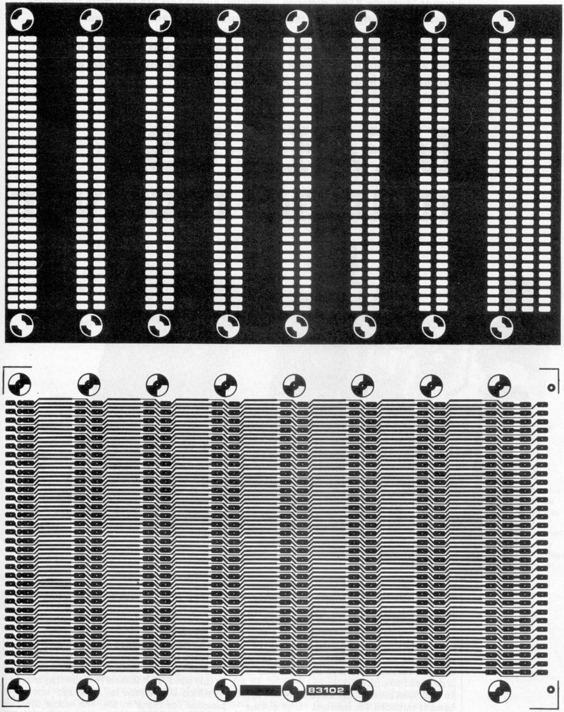


Figure 1. This is how the connectors are mounted. Particular care must be taken with the two outside connectors.

2



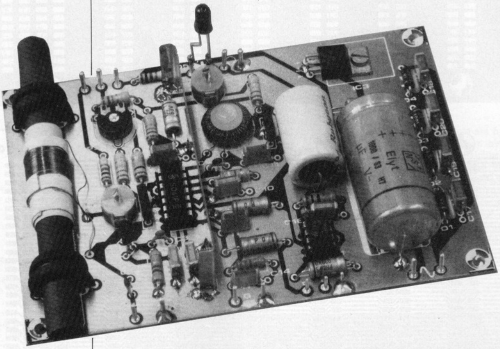
changed).
As there are two types of angled female connectors available, one with 2.5 mm between the rows and the other with 5 mm, we have made the printed circuit board compatible with both 'a + b' and 'a + c' types.
Remember to connect the earth plane on the upper side of the board to the '0 V' pins of connectors 0 and 8! ◾

This bus can easily be used for the Junior Computer, but in this case connector no. 8 should be omitted. In its place, the output connector of the interface card should be connected by means of *crossed* wires, so that the 'a' row of the interface card is linked to the 'c' row of the bus, and vice versa.

Figure 2. The copper-clad side of the board acts as an earth plane. Connectors 0 and 8 mount parallel to the board whereas all the remaining (polarised) connectors mount vertically. If cards are to be fitted and removed frequently the female con-connectors should be provided with guide rails.

For some time now, a number of our readers, fervent DXers, have been asking for a follow-up to our short-wave SSB receiver (June 1982). DX literally means 'distance X' or 'distance unknown' and DXers are therefore hobbyists interested in long-distance radio communication (transmission and/or reception). Apart from these enthusiasts there are thousands of other people interested in listening to what goes on at sea and it was with them in mind that we thought it would be a good idea to design an inexpensive receiver for operation in the 1600 . . . 4000 kHz band.

MF/HF USB marine receiver



Radio traffic in the 1600 . . . 4000 kHz band comprises CW (ICW and MCW, often just called 'morse'), RTTY (radio teletype), radio facsimile, and plain telephony. For most DXers, morse and telephony are, of course, the most interesting and it is these that the receiver described in this article is designed to process.
In principle, most of the 1600 . . . 4000 kHz band is intended for medium range marine communications: longer distances are served by maritime bands on higher frequencies. A substantial part of the traffic in this band is concerned with

- weather reports
- warnings to shipping
- storm and gale warnings
- traffic lists

These are all services supplied free to shipping by the various national administrations and which can therefore be listened to by anyone. It is as well to point out now that it is NOT allowed to listen in to private telephone conversations and like traffic: if you do by accident, NEVER repeat it to third parties.
The services mentioned above are invariably preceded by an announcement on 2182 kHz, the international distress and call frequency in this band. This is therefore the frequency to which DXers tune in. Although not so pleasant for those at sea, the worse the weather, the more lively things become for the DXer. The number of weather reports and warnings to shipping is approximately directly proportional to the wind force! However, even when the weather at sea is good, there is much of interest going on . . .
Traffic lists are lists of names of ships for which a particular coast station has messages. Such lists are transmitted regularly throughout the day, always preceded by an announcement on 2182 kHz. The announcement includes the information at which fre-

1

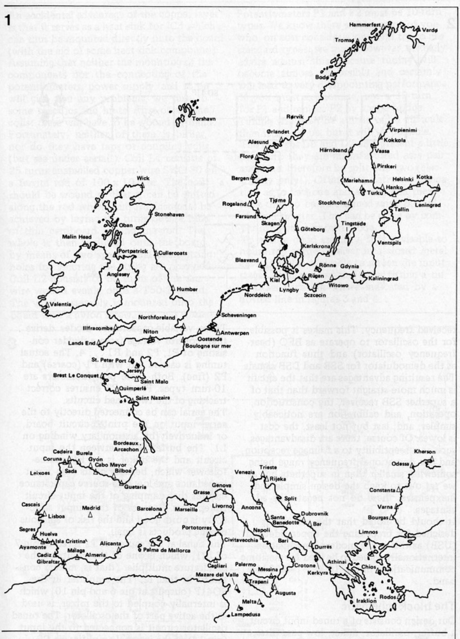


Figure 1. Coast stations which can be received in Europe. Frequencies cannot be given, but these can be ascertained by listening diligently on the international distress and call frequency of 2182 kHz.

quency the coast station is about to transmit the lists. If a ship finds that its name is included on the list, it will call the coast station – again on 2182 kHz – to arrange the frequencies on which the messages will be transmitted and received.

A simple chart of the most important European coast stations is shown in figure 1. It should be possible to receive most of these stations when conditions are good. Unfortunately, frequencies in the 1600 . . . 4000 kHz band are affected by the so-called D-layer which, in contrast to other layers such as the E and F, absorbs rather than reflects them. As long-distance radio communication depends heavily on reflected waves, it is therefore badly curtailed in the presence of the D-layer. However, after sunset this layer disappears and reception over much longer distances than during daytime becomes possible. The evening hours are therefore best for DXing in this particular band.

So much for a short introduction to the why, where, and how? Now for the actual receiver . . .

Direct conversion

As we wanted the receiver to give good performance and yet be relatively simple and inexpensive to build, we opted for a direct-conversion design. For those who have forgotten (or never read) our June 1982 articles 'the principles behind an SSB receiver' and 'compact short-wave SSB receiver', here is a short resume. The basic principle of a direct-conversion receiver is that the radio signal is converted into an audio signal without the use of intermediate frequencies. The layout of such a receiver is strongly reminiscent of that of a superheterodyne but the oscillator frequency is equal to the

2

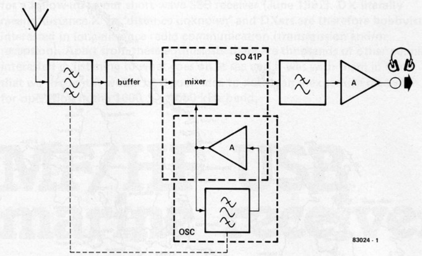


Figure 2. The receiver described operates on the direct-conversion principle. Apart from the tuned-oscillator circuit, the mixer and oscillator are contained in one type SO41P IC. The input and oscillator circuits are ganged.

received frequency. This makes it possible for the oscillator to operate as BFO (beat-frequency oscillator) and thus function as the demodulator for SSB and DSB signals. The resulting advantages are that the circuit is much more straight forward than that of a superhet SSB receiver, the construction, operation, and calibration are noticeably simpler, and, last but not least, the cost is lower. Of course, there are disadvantages, such as susceptibility to a.f. image reception, and the operational frequency range being somewhat smaller than in superhets but as we set out to keep the design simple and inexpensive, these do not negate the advantages.
It should be noted that the receiver is designed for processing the upper sideband (USB) as this is the mode of modulation internationally agreed to be used for maritime communications in the 1600 . . . 4000 kHz band.

The block schematic

Our design consists of a tuned input circuit, a buffer, oscillator, mixer, low-pass filter, a.f. amplifier, and sound transducer as can be seen in figure 2. Input and oscillator circuit tuning are, of course, 'ganged'. For those who want a little more than a 'minimum receiver', there are facilities for connecting an additional low-pass filter (to give improved selectivity), and a frequency counter (to provide a precise frequency read-out).

The circuit diagram

The various blocks of figure 2 can be readily recognized in the circuit diagram in figure 3. The tuned input circuit consists of L1, C24, and D6; T1 funcions as the buffer, and IC1 contains the mixer and oscillator. The tuned oscillator circuit comprises L2, C23, and D7. The low-pass filter consists of just one capacitor, C7, and the a.f. amplification is provided by IC2.
The input and oscillator circuits are tuned by means of varicaps D6 and D7 respectively. These variable-capacitance diodes derive their control voltage from a divider consisting of P1, P2 and R1 . . . 4. The actual tuning is carried out with P1 (coarse) and P2 (fine). Both these potentiometers are 10-turn types. Preset P3 ensures correct tracking of the two tuned circuits.
The aerial can be connected directly to the aerial input on the printed-circuit board, or inductively by a secondary winding on L1. The buffer (T1) between the input circuit and the mixer is a FET source-follower which, because of its high input impedance and low gate-source capacitance, ensures that damping of the input circuit is kept low. Because of that, input selectivity is quite good and the risk of spurious mixing products is small.
The signal at the source of T1 is fed to pin 7 of IC1, which is one of the inputs of the quadrature multiplier (that is, mixer) contained in that IC. The amplifier in the SO41P (outputs at pin 6 and pin 10) which is internally coupled to the mixer, is used as the active part of the oscillator. The tuned oscillator circuit is connected to the input (pin 14) of the internal amplifier via C9.
The a.f. output of the mixer is taken to the audio amplifier, IC2, via a simple low-pass filter (C7) and volume control P4. The a.f. amplifier can drive high or low impedance loudspeakers or headphones.
The power supply consists of the usual bridge rectifier, D1 . . . D4, a smoothing capacitor, C21, and a voltage regulator, IC3. Resistors R11, R12 and capacitors C17 . . . 20 ensure minimal interference from the mains supply. The LED, D5, functions as the on/off indicator.

Construction

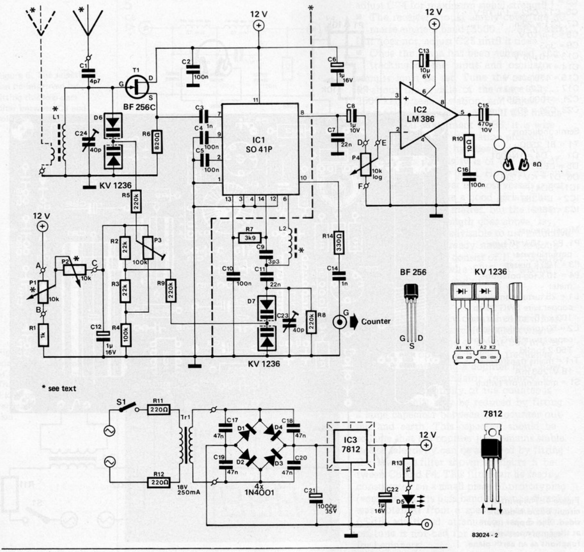
The receiver is constructed on a double-sided printed-circuit board as shown in figure 4. As you probably know, double-sided means that the component side of the board is provided with a copper layer which functions as an earth plane. All components connected to earth must therefore be soldered at both sides of the board.

An accidental advantage of the copper layer is that it serves as a heat sink for IC3 which can thus be mounted directly onto the board (with the aid of some heat-sink compound). Assuming that neither the mounting of the components nor the connecting of the potentiometers, power supply, and so on will give you any problems, we turn to some specifics and hints. First of all, the coils: these will have to be wound by hand. Fortunately, neither of them is bifilar, nor do they have taps or coupling coils (but see under aerial!). Coil L1 consists of 25 turns enamelled copper wire SWG 30 on a ferrite rod of 100 x 10 mm. The coil should be wound so that it can be shifted along the rod which can, for instance, be achieved by laying the turns onto a tube of thin cardboard around the rod. The whole is then mounted onto the board by means of two spacers and some string: holes for securing the string are provided. Coil L2 consists of 50 turns of the same wire wound evenly onto a T50-2 toroid. The whole assembly is mounted onto the board with a nylon screw, nut, and washer.

Potentiometers P1 and P2 must be 10-turn types. We know there will be some of you who, on cost considerations, will try to use standard types: we must, however, strongly advise against this, because tuning will become almost impossible and certainly will lead to very disappointing performance. If you must economize, use a 10-turn for P1 and replace P2 by a wire bridge. Tuning will then be a little more difficult than it should be, but it will be possible.
The varicaps D6 and D7 also present a little problem: they are manufactured as a pair and must therefore be split into two (electrically only!). Often they carry no indication as to cathode and anode, and these have thus to be ascertained with the aid of a multimeter. This can be done by comparison with a known diode.
To ensure good stability, it is advisable to house the entire receiver in a closed metal case. It is also advisable to screen the input stages from the remainder by fitting a tin or brass partition where indicated by a dotted line in figures 3 and 4.

Figure 3. The circuit diagram is conspicuous by its simplicity: one FET, two ICs, a stabilizer, and some passive components. Tuning is effected by means of varicaps D6 and D7.

3



Parts List

Resistors:

R1, R13 = 1 k
R2, R3 = 22 k
R4 = 100 k
R5, R8, R9 = 220 k
R6 = 820 Ω
R7 = 3k9
R10 = 10 Ω
R11, R12 = 220 Ω
R14 = 330 Ω

Capacitors:

C1 = 4p7
C2, C4, C5, C10, C16 = 100 n
C3 = 1 n
C6, C12, C22 = 1 μ/16 V
C7, C11 = 22 n
C8 = 1 μ/10 V
C9 = 3p3
C13 = 10 μ/6 V
C14 = 1 n
C15 = 470 μ/10 V
C17 . . . C20 = 47 n
C21 = 1000 μ/35 V
C23, C24 = 40 p trimmer

Semiconductors:

T1 = BF 256C
D1 . . . D4 = 1N4001
D5 = LED
D6, D7 = KV 1236
IC1 = SO41P
IC2 = LM 386
IC3 = 7812

Miscellaneous:

P1, P2 = 10 k 10-turn potentiometer
P3 = 100 k preset
P4 = 10 k log potentiometer
L1 = 25 turns enamelled copper wire SWG 30 on 100 x 10 mm ferrite rod
L2 = 50 turns enamelled copper wire SWG 30 on T50-2 toroid
Tr1 = mains transformer 18 V/250 mA
S1 = mains on/off switch

4

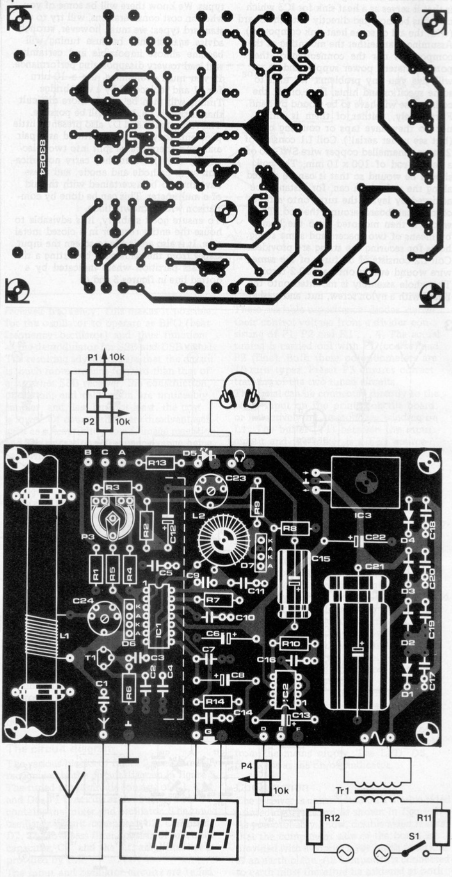
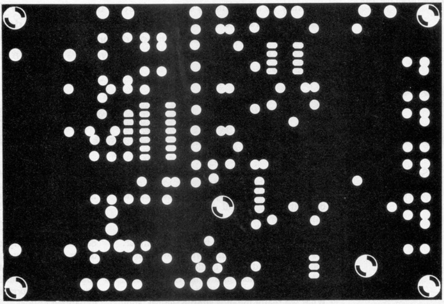


Figure 4. The printed-circuit board is double-sided. The copper layer at the component side functions as an earth plane.



5

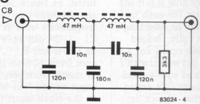


Figure 5. The selectivity can be improved by fitting this low-pass filter between C8 and volume control P4.

Calibration

The receiver can be calibrated without the use of expensive test instruments.

- Use a length of wire of not less than three metres as a test antenna and connect this to the aerial terminal on the printed circuit board.
- Set C23, C24, and P3 to their mid-position.
- Turn P1 to the lowest frequency (lowest tuning voltage) and then seek a broadcasting station or interference whistle in that region (of about 1600 kHz).
- Shift L1 along the ferrite rod until the received signal is strongest.
- Turn P1 to the highest frequency band (3500 . . . 4000 kHz), seek a station, and adjust C24 for maximum signal strength.
- The receiver should amply cover the 80 metre amateur band (3500 . . . 3800 kHz). If it does not, adjust C23 until it does.
- Once the range has been achieved, the tracking of the input and oscillator circuits must be set. Tune the receiver to about the middle of the range (say, 2500 kHz), seek a station, and adjust P3 for maximum signal strength. If this means a substantial adjustment of P3, it is wise to repeat the entire calibration procedure.

When the receiver has been calibrated correctly, its sensitivity is of the order of 1 μV, which is quite good. However, because the transmitter power of most vessels is not high, it pays to have a good aerial. This should be at least 3 metres, but the longer, the better! If the length goes above, say, twenty metres, it is advisable to use inductive aerial coupling as already stated. The coupling winding should consist of . . . 3 turns enamelled copper wire SWG 30 wound around the 'earthy' end of L1.

Extensions

Connect a frequency counter to terminal G on the printed-circuit board (where the oscillator voltage of about 250 mV is present) to obtain a precise frequency read-out. Connecting a counter may, however, cause the oscillator frequency to shift. If the sensitivity of the counter is good, this shift may be reduced by fitting a large capacitor between the counter output and earth. This capacitor should be so large that the counter just remains stable. Better selectivity can be achieved by fitting the low-pass filter shown in figure 5 between C8 and P4. This filter can be readily constructed on a small piece of prototyping (vero) board. Its pass band shown in figure 6 was obtained from a spectrum analyzer: 65 dB additional attenuation at 6 kHz off-tune is not bad for a receiver intended for beginners!

6

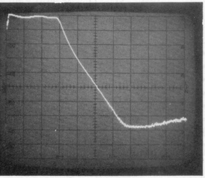


Figure 6. Spectrum analyzer photograph of the filter in figure 5. The horizontal scale is 1 kHz per division: the vertical 10 dB per division.

Around this time of the year even the most hardened of electronic hobbyists is likely to be thinking of a completely different type of circuit than the usual ones. Now a circuit does not necessarily have to do anything, except maybe play a game or simply look decorative. Of course, electronics is totally suited to this sort of task and, as we have always known, electronics can just be good fun.

LED ornaments

seasonal electronics

The purpose of this article is to give any 'not entirely sane' handymen among you a few ideas. What we have in mind is making decorative, colourful 'LED ornaments', suitable for hanging on the Christmas tree, or as an exclusive brooch (with a battery in an inside pocket) or something similar. To anyone not familiar with electronics, especially children, it could be something totally fascinating, and it is also an idea for a unique Christmas present.

What we really mean is simple figures, such as those shown in figure 1. They consist of nothing more than a group of LEDs arranged in a certain pattern. Exactly how it is made and how big it is is a matter for each to decide for himself. It could be anything from a simple brooch to a fully fledged star with all the options. We opted for a star, cut from a piece of plywood with holes drilled for the LEDs and with a good coat of a suitable colour paint. We ended up with something like that shown in figure 2. This is only intended as an example as it could be constructed in any number of ways.

Flashing electronics

Simply having a display of LEDs is all very well, but as an electronics hobbyist you are more or less obliged to make the LEDs flash. Only then can it really be called 'eye-catching'. It is not at all difficult, but there are a few basic elements required. In its simplest form the electronics needed consist of an oscillator for the flash timing, a divider, and the LED driver. A few suggestions are shown in figure 3.

If there is not very much room to play with then one of the four oscillators from figure 3a, the divider (figure 3c) and a few of the driver stages drawn in figure 3d are all that are strictly essential. If there is more space available, taking a bit more time and a few more components, the circuit can be expanded.

Instead of using one oscillator, for example, four switchable oscillators could be substituted, as figure 3a shows, so that different rhythms can be chosen. The clock frequencies used is a question of taste. C1 . . . C4 can have any value from 100 n to 100 μ and R1 . . . R4 can be any resistance from 10 k to 10 M. That gives a range of speeds from very slow to very fast. The wiper of the four-way switch is connected to the clock input (CL) of the divider IC (figure 3c).

The oscillator of figure 3b is also a nice possibility. This automatically supplies different rhythms of its own accord, without any need for switching. When S1 is open the CL output alternately supplies high and low frequency clock pulses. If S1 is closed the high and low frequency pulses follow each other at random.

The divider circuit of figure 3c requires little comment. This is a straightforward appli-

1

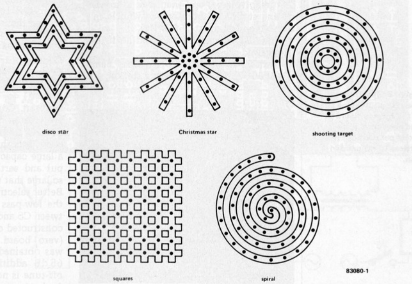


Figure 1. Here we show just a few of the countless designs that can be made with a few LEDs. Use your imagination. Unfortunately it is not possible to show the colours here, but almost all the colours in the spectrum are available.

cation of a well known decade counter IC. If all ten outputs are to be used, then the reset input (pin 15) must be connected to ground. Otherwise this pin should be connected to one of the 0 . . . 9 outputs, so that whenever this output is reached the counter goes back to '0'.

The LEDs

Now the LED drivers. As the decade counter of figure 3c cannot drive the LEDs directly, each output must be followed by a transistor stage. The simplest version is shown in figure 3d. Each transistor can drive a number of LEDs connected in series. The value of the series resistor can be calculated by subtracting the total voltage drop across the LEDs from the supply voltage and then dividing this by the current that is to flow in the LEDs:

$$Rx = \frac{U_b - (n \cdot U_{LED})}{I_{LED}}$$

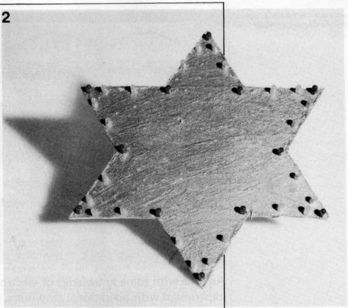
Both U_{LED} and I_{LED} depend on the type used. The voltage drop across red LEDs is generally 1.6 V; for yellow it is approximately 1.9 V and for green the norm is about 2.2 V. The current required can vary between 10 and 50 mA.
An expanded LED driver stage is shown in figure 3e. In this case transistor T1 is protected by the current limiting components, T2 and R2. Given a supply of 15 V, this stage can drive a maximum of six and a minimum of three LEDs in series. Fewer LEDs cannot be used here or T1 will have to dissipate too much current. The LED current is determined by the choice of R2. The value of this resistor is easily calculated by dividing the voltage drop across this resistor (= the base/emitter voltage of T1 = 0.6 V) by the current required:

$$R2 = \frac{0.6}{I_{LED}}$$

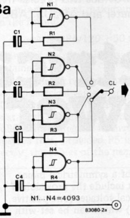
From theory to practice

By now you should have all the information you need to start making your own original LED ornaments (except maybe which end of a fret saw is the sharp end).
The power supply can in principle be kept very simple, but it should not be underrated. The oscillator and divider certainly require little current, but the LEDs need quite a bit more. If a voltage of 15 V and the full ten channels are to be used, then for a LED current of 10 mA the supply must be able to provide at least 100 mA. If the LEDs draw even more current the total consumption can rise to as much as 0.5 A (if I_{LED} is 50 mA). The final design of the power supply therefore depends on the number and type of LEDs used.
Finally . . . while we are on the subject of LEDs. There seems to be an ever-increasing number and variety of LEDs available today and you may be wondering which to use. The majority are perfectly suitable for our purposes here, but the best are the diffused coloured types. These have a wide viewing angle and remain visible from a distance even if you are not standing straight in front of them. ◀

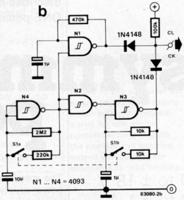
2



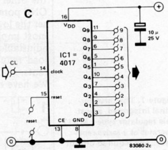
3a



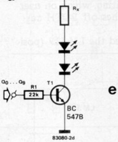
b



c



d



e

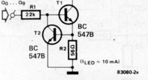
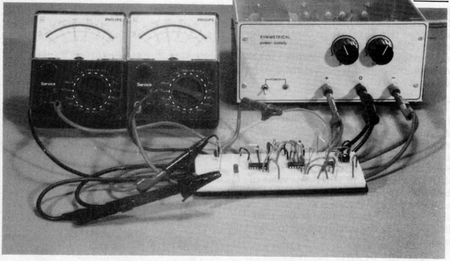


Figure 2. Our 'prototype' shown here actually involves more carpentry than electronic ability.

Figure 3. Driving the LEDs. Figures a and b show two variations for the oscillator. The output (CL) goes to the decade counter of figure c, each of the outputs (0 . . . 9) of which can be followed by a transistor stage (d or e) driving one or more LEDs.



Anyone with some knowledge of electronics knows that to be able to experiment with operational amplifiers, or to check circuits using them, a symmetrical power supply is virtually indispensable. The power supply described here provides two precise INDENTICAL voltages which are set by ONE potentiometer and ADJUSTABLE current-limiting.

symmetrical power supply

0 to ± 18 V; 0 to ± 1 A

The specification of a symmetrical mains power supply must include the provision of two precise, identical voltages (one positive, the other negative) which can be set with ONE potentiometer. It must be possible to set the lowest voltage to 0 V. And, perhaps most important of all, the unit must have adjustable current-limiting, which on overload reduces or switches off BOTH currents.

We have not often used the LM 317 (positive) and LM 337 (negative) adjustable voltage regulators in our designs and a few words about these devices may, therefore, not come amiss. They are very easy to use and require only two external resistors to set the output voltage and an output capacitor for frequency compensation. In addition to higher performance than fixed regulators, they offer thermal and electrical overload protection, current limiting, and safe-area protection. The overload pro-

1

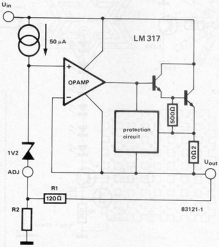


Figure 1. The three-terminal integrated, adjustable regulator type LM 317 operates as a series regulator. The required output voltage is obtained by adding voltage divider R1/R2. The minimum load current is set to 10 mA by means of R1.

Table 1

■ Output voltage		
(LM 317)	1.2 . . .	37 V
(LM 337)	−1.2 . . .	−37 V
■ Line regulation, typically		0.01%/V
■ Load regulation, typically		0.1%
■ Reference voltage		1.2 V
■ Adjustment pin current		50 µA
■ Minimum load current		3.5 mA
■ Temperature stability		0.01%/°C
■ Current limiting (constant with temperature)		2.2 A
■ Ripple rejection (LM 317)		80 dB
(LM 337)		77 dB
■ Thermal regulation		
(LM 317)		0.04%/W
(LM 337)		0.03%/W

tection circuitry remains fully functional even if the adjustment terminal is disconnected. The 'K' versions are packaged in the standard TO-3 transistor housing. The operating temperature range is 0 . . . 125°C. Further features are shown in table 1.
For those who may have forgotten: a series voltage regulator is a circuit in which a 'ballast' transistor, controlled by an amplifier, is used as a preset resistor in series with the load. This transistor absorbs any superfluous voltage.

Principle of operation

The operation of a voltage regulator (in this case the LM 317) may be described with the aid of figure 1 in which an operational amplifier (opamp) drives a power darlington transistor. The opamp and the circuit providing the d.c. bias for the regulator are arranged so that the quiescent current flows to the output of the regulator instead of to earth (hence no earth connection!). The reference voltage of 1.2 V appears between the non-inverting input of the opamp and the ADJ(ustment) pin. The quiescent current for the reference-voltage source is set to 50 μA and emerges from the ADJ pin. In actual operation, the output voltage of the IC is equal to the voltage at the ADJ pin plus 1.2 V. If you therefore connect the ADJ pin to earth, the regulator functions as a 1.2 V reference voltage source. Higher voltages are arranged by means of voltage divider R1/R2. As the reference voltage appears across R1, a current of 10 mA flows through the voltage divider. This current also flows through R2 and thus increases the voltage at the ADJ pin. The real output voltage is therefore given by the formula

$$U_{out} = [1.2\ (1 + R2/R1) + 50 \times 10^{-6} \times R2]\ V$$

As we're dealing with a series regulator, the quiescent current is taken off the load current. If the latter becomes very small, the regulation is affected. It's for that reason that the minimum load current is set (by means of R1) at 10 mA.

The circuit

The complete circuit diagram in figure 2 is, of course, more complex than that of the regulator in figure 1. But remember what we said at the beginning: it must be possible to preset both the positive and the negative voltage with one potentiometer, the output voltage must go down to 0 V, and the current limiting must be adjustable.
Regulation of the positive output voltage is effected by an LM 317 and that of the negative output by an LM 337. Because of the voltage drop across diodes D7 and D8, the wiper of potentiometer P4 is at −1.2 V, provided T1 does not conduct. Substituting the minimum and maximum values of P4 in the formula

$$U_{out} = [1.2P4/120 + 50 \times 10^{-6} \times P4]\ V$$

a range of output voltages of 0 . . . 22 V is obtained.
The setting of both output voltages to the same numerical value is arranged by opamp IC8. As the non-inverting input of this IC is at earth potential, its output will closely follow the voltage at its inverting input. This ensures that, provided P5 is adjusted correctly, the values of the negative and positive

2

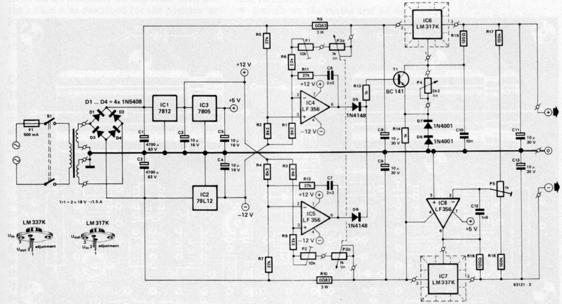
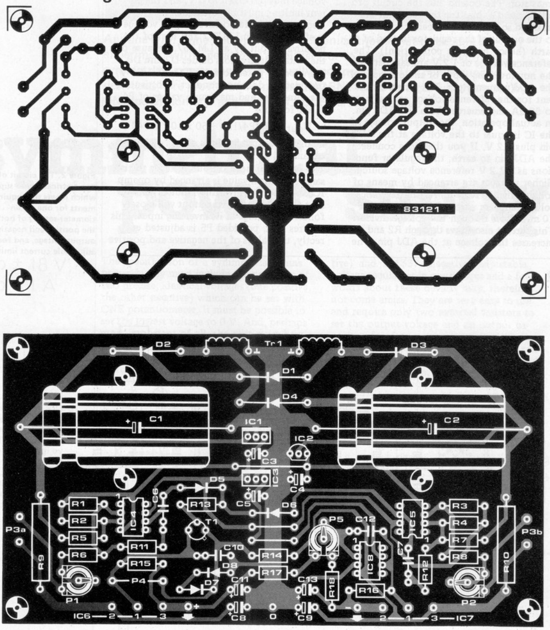


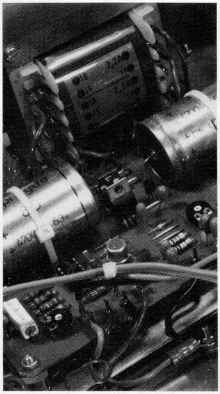
Figure 2. The circuit of the symmetrical power supply which meets the requirements for one potentiometer-setting of both the positive and negative output voltage, and for adjustable current limiting.

output are the same. Capacitor C12 slows down the regulating action of IC8 to some extent so that any tendency of IC7 to oscillate is effectively suppressed.
It should be noted that the operating voltage of IC8 is asymmetrical: +5 V and −25 V. This gives, of course, the maximum operating voltage of 30 V for this IC. The asymmetry is necessary to ensure that the output of IC8 can go down to at least −18 V, otherwise it would not be possible for the negative output voltage to reach this value.
Voltage regulators IC1 . . . 3 merely provide the stabilized supply voltages for the opamps. The input voltages for the adjustable regulators, IC6 and IC7, are provided by capacitors C1 and C2 respectively. These electrolytic capacitors are as large as possible to ensure that the ripple voltage is kept to a minimum and that the rectified voltage does not drop below the required input level of the regulators.
Last, but not least, the adjustable current limiting. In the positive leg this is effected as follows. A reference voltage derived from voltage divider R5/R2 is applied to the non-inverting input (pin 3) of opamp IC4. If the ratio of voltage divider P3a-P1-R6/R1 is the same as that of R5/R2, the voltage at the inverting input (pin 2) at maximum load current will be smaller than that at pin 3 (because of the voltage drop across current sensing resistor R9). The output of the opamp becomes positive and switches on

Figure 3. Component layout and trackside of the printed circuit board for the power supply. The two adjustable regulators must be fitted with heat sinks – DO NOT FORGET ISOLATING WASHERS!

3





4

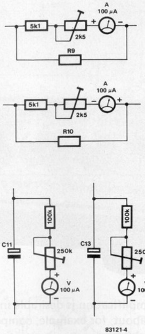


Figure 4. Optional instruments for incorporating in the power supply enable direct reading of output voltage and load current.

transistor T1. The resulting current through T1 ensures that the output of both IC6 and IC7 is returned to the predetermined reference level. The level at which current limiting commences is set by potentiometer P3a.
The current limiting action in the negative leg is similar, but here the voltage level at the non-inverting input (pin 3) of IC5 becomes greater than that at pin 2 at the onset of current limiting. Again, the opamp switches on transistor T1 and from then on the action is as described for the positive leg. P3 is a stereo potentiometer so that the current limiting can be set to commence at the same level in both legs.

Construction and calibration

The use of the printed-circuit board shown in figure 3 makes the mounting of most components simplicity itself. The usual care should be taken to observe polarity where necessary and to avoid dry soldering joints. The remainder is primarily a problem of constructing a suitable housing for the unit.
The front panel should be provided with holes for P3 and P4, the output terminals, and the mains on/off switch. The rear panel must have holes for fitting the adjustable regulator-ICs and their heat sinks, and mains fuse. Once this work has been done, the wiring between all these components and the printed-circuit board can be completed. When the wiring has been completed and carefully checked, the unit can be calibrated.

- Set presets P1 and P2, and potentiometer P3, to minimum resistance – check this with an ohmmeter.
- Connect a voltmeter to the positive-voltage output terminal; if a second one is available, this may be connected to the negative-voltage terminal. (Be careful to observe polarity!)
- Switch on the mains, and check that adjusting P4 causes a change in both output voltages. Adjust preset P5 to give equal numerical values for these voltages.
- Switch off the mains, and connect a 1 Ω/5 W resistor to both the positive and negative output terminals, in parallel with the voltmeter(s).
- Switch on the mains and adjust P4 for maximum output voltage(s). Set P3 so that the voltage across the 1 Ω resistors increases; check that when P3 is turned back, the voltage decreases.
- Set P3 for maximum voltage across the 1 Ω resistors and then adjust P1 and P2 so that the voltage across these resistors is exactly 1.000 V. The current will then, of course, be exactly 1 A. In our laboratory prototype, it was possible with P3 to set the current limiting between 15 mA and A.

Many of you will find it worthwhile to build in the meters shown in figure 4. The reading and setting of voltage and current levels is then much easier. Do not, however, calibrate these instruments until you are sure that the supply unit is functioning satisfactorily. ◼

Parts list

Resistors:
R1 . . . R4 = 8k2
R5,R7,R11,R12 = 27 k
R6,R8 = 22 k
R9,R10 = 0,82 Ω/3 W
R13,R14 = 1 k
R15,R16 = 120 Ω
R17,R18 = 100 k
P1,P2 = 10 k preset
P3 = 1 k linear stereo potentiometer
P4 = 2k2 linear preset
P5 = 1 k preset

Capacitors:
C1,C2 = 4700 µ/63 V electrolytic
C3,C4,C5 = 10 µ/16 V tantalum
C6,C7 = 2n2 ceramic
C8,C9,C11, C13 = 10 µ/30 V tantalum
C10 = 10 n ceramic
C12 = 1n8 ceramic

Semiconductors:
D1 . . . D4 = 1N5408
D5,D6 = 1N4148
D7,D8 = 1N4001
T1 = BC 141
IC1 = 7812
IC2 = 79L12
IC3 = 7805
IC4,IC5,IC8 = LF 356
IC6 = LM 317K
IC7 = LM 337K

Miscellaneous:
S1 = double-pole mains switch
F1 = miniature fuse holder and fuse 0.5 A
Tr1 = mains transformer 2 x 18 V/1.5 A
Heat sinks for two TO-3 ICs
Printed circuit board 83121
Output terminals
Four 100 µA meters as required

Extra amplification is desirable in almost every extended video chain. We are talking about, for example, compensating for losses in cables, strengthening the signal from a not very sensitive input, or other applications where signal levels have to be tuned in to each other.
This simple amplifier is ideal for all these applications. Furthermore it also acts as a distributor as it is equipped with three outputs as standard.

video amplifier

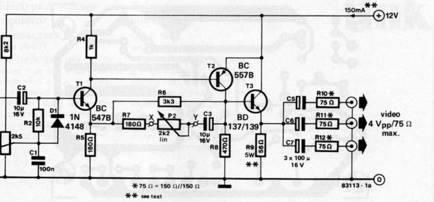
universal amplifier and distributor for video signals

A video amplifier rarely needs a high gain. By 'high' we mean a factor of 100 or more, as is the norm for audio pre-amplifiers. For adjusting video levels a gain factor of 2 or 3 times is generally called for – maybe a bit more in a few cases.
In this circuit we have made the amplification adjustable between 1 x and a good 4 x, so that the amplifier is suitable for almost any situation where boosting is needed. The maximum output voltage is 4 V_{pp}, and the input and output impedance is, of course, set at 75 ohms.
As well as being a normal amplifier, this circuit can also be used as a video signal distributor, which is handy if more than one channel in a video chain are to be driven from one video signal. As we have already said, the amplifier has three outputs. However, that is not to say that they all have to be used. The circuit can also be used with just one or two outputs.
Now the only data needed to complete the technical specification of the amplifier is the bandwidth. This is at least 5 MHz providing the specified semiconductors are used.

The circuit diagram

A good video amplifier need not be very complicated, as is shown by figure 1a. The circuit contains a very ordinary two-stage amplifier (T1/T2) followed by an emitter follower. The transistors used are simply normal BC and BD types because these can quite easily fulfil the required conditions for adequate bandwidth. A nice side-effect is, of course, that these transistors are relatively cheap, and in this case expensive HF types are simply not needed.
The input impedance is set to 75 ohms by R1. The signal travels from the input via C2 to the base of T1. Because the content of the video signal can change a lot, the d.c. current setting of T1 is provided by a small circuit (R3, P1, C1, R2 and D1). The maximum output voltage swing of the amplifier can be set using P1. We will deal with setting this potentiometer later. The base of transistor T2 is connected directly to the collector of T1 thus forming a direct coupled amplifier, the amplification of which can be varied with potentiometer P2 in the feedback network. The amplification factor is defined by the ratio between R5 and the resistance of the R6/R7/P2/C3 network. With the values we have used, P2 covers a range of 1.95 x to 8.7 x. With the

1a



1b

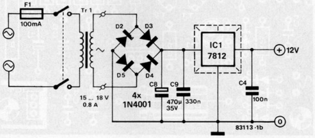


Figure 1. The circuit is very simple to construct and contains very ordinary components. The amplification can be adjusted with P2 between 1 x and 4 x.

normal output load of 75 ohms the final amplification is effectively halved, so that the actual range is from 1 x to just over 4 x.

The T1/T2 stage is followed by a 'bigger' transistor (T3), which has to ensure the desired low frequency output impedance. This demands a very small emitter resistor (R9) and an accordingly high collector current. The amplified signal leaves the circuit by three 75 ohm outputs, made up of C5/C6/C7 and R10/R11/R12.

If only one or two of the three outputs are needed, then obviously the power consumption of the circuit will be correspondingly less. The greatest part of the current consumption is in R9. If three outputs are used R9 must be 56 ohms, with two outputs it can be increased to 82 ohms and with one output 150 ohms is sufficient. The total current consumption for the three conditions is then 150 mA, 110 mA and 70 mA respectively.

Adjustment

There are two ways of adjusting P1. The 'normal' method, which gives satisfactory results 90% of the time, and an alternative for setting it up 'by eye'. In the first case, P1 is simply adjusted so that there is about 1 V at the base of T1. The voltage across R8 should then be about 7.5 V (with no signal).

The alternative method is somewhat more involved. Start by setting P1 to mid position and with an input signal of about 1 V_{pp} reduce the amplification to minimum with P2. Then a test image is fed into the input (from a video recorder, for example), and a TV set or monitor is connected to the output. P1 is now adjusted so that all distortion is just eliminated.

Another point which may be of importance. Although input signals a bit higher than the nominal 1 V_{pp} are not a direct disadvantage to the amplifier, they are actually of little use. Significantly higher voltages can therefore better be reduced. This can be done by experimenting with R5 and using a bigger resistor here (the maximum amplification then decreases) or by placing an extra resistor in series with the input, so that it forms a voltage divider with R1. Then the value of R1 is reduced so that the total resistance of the extra resistor and R1 add up to 75 ohms.

Construction

A simple power supply for the amplifier is easily built, as figure 1b shows. Both amplifier and power supply are constructed on the same printed circuit board, the layout

2

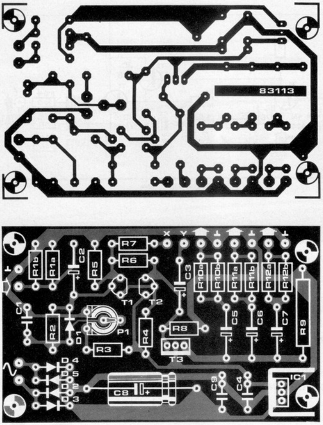
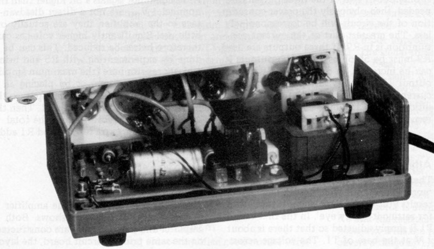


Figure 2. The printed circuit board contains both the amplifier and power supply. Only the mains transformer is not mounted on the board.

of which is shown in figure 2.
'Construction' is really only a matter of fitting everything correctly to the printed circuit board and soldering it there. However, there are a few points to note. When three outputs are in use voltage regulator IC1 has to work reasonably hard and because of this it needs to be mounted on a heatsink. The 75 ohm resistors (marked with an asterisk) are not standard E12 values. They actually consist of two 150 ohms connected in parallel.

Very little needs be said about mechanical construction for this project. Depending on circumstances, it could be built into the case of some existing equipment, or it could be mounted in a case of its own. The only important point is that the 'amplification' pot must be freely accessible. ◾



Parts list

Resistors:
R1,R10 . . . R12 = 75 Ω*
R2 = 10 k
R3 = 8k2
R4 = 1 k
R5,R7 = 180 Ω
R6 = 3k3
R8 = 470 Ω
R9 = 56 Ω/5 W**
P1 = 2k5 preset
P2 = 2k2 linear
*75 Ω = 150 Ω ‖ 150 Ω
**see text

Capacitors:
C1,C4 = 100 n
C2,C3 = 10 μ/16 V
C5 . . . C7 = 100 μ/16 V
C8 = 470 μ/35 V
C9 = 330 n

Semiconductors:
D1 = 1N4148
D2 . . . D5 = 1N4001
T1 = BC 547B
T2 = BC 557B
T3 = BD 137/139
IC1 = 7812

Miscellaneous:
S1 = double pole mains switch
F1 = 100 mA slow blow fuse
Tr1 = 15 V, 0.8 A mains transformer
Heatsink for IC1
Case, approximate dimensions 120 x 65 x 65 mm

missing link

Personal FM

(September 1983, page 9-46)

The 0.22 μH Toko coils for L1 and L2 should be of the small axial-leaded type. Alternatively, they can quite easily be wound. The correct inductance can be obtained by winding 13 turns of SWG 27 enamelled copper wire on a 3.5 mm 'former' (we used the plastic refill for a well-known ballpoint pen). L3 is listed as stock number 35-01144 in the Ambit catalogue under the heading 'coil style MC 120'.

Electronic voltage regulator

(October 1983, page 10-57)

The text for this article states that this circuit will work with a d.c. dynamo. The theory behind the regulator does apply for d.c. dynamos, but this particular circuit will only work with an alternator.

7-day timer/ controller

(April 1983, page 4-42)

In a few cases difficulties are encountered with the string of the switching data. This is caused by an incorrect trigger level at IC5. The remedy consists of reducing the value of C8 down to 1 nF (but not lower), if necessary.

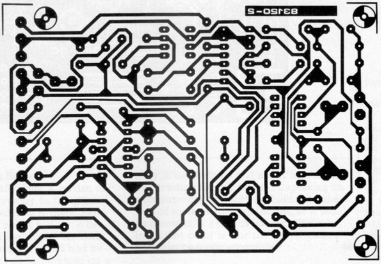
service

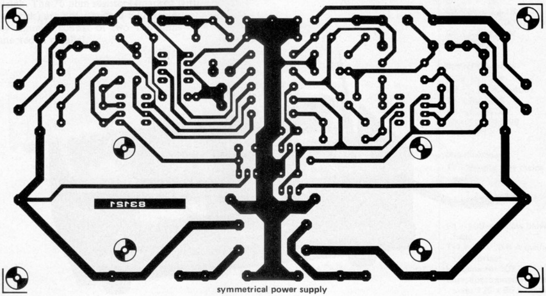
PC board pages

The following pages contain the mirror images of the track layout of the printed circuit boards (excluding double-plated ones as these are very tricky to make at home) relating to projects featured in this issue to enable you to etch your own boards.

- To do this, you require: an aerosol of 'ISOdraft' transparentizer (available from your local drawing office suppliers; distributors for the UK: Cannon & Wrin), an ultraviolet lamp, etching sodium, ferric chloride, positive photo-sensitive board material (which can be either bought or home made by applying a film of photo-copying lacquer to normal board material).
- Wet the photo-sensitive (track) side of the board thoroughly with the transparent spray.
- Lay the layout cut from the relevant page of this magazine with its printed side onto the wet board. Remove any air bubbles by carefully 'ironing' the cut-out with some tissue paper.
- The whole can now be exposed to ultra-violet light. Use a glass plate for holding the layout in place only for long exposure times, as normally the spray ensures that the paper sticks to the board. Bear in mind that normal plate glass (but not crystal glass or perspex) absorbs some of the ultra-violet light so that the exposure time has to be increased slightly.
- The exposure time is dependent upon the ultra-violet lamp used, the distance of the lamp from the board, and the photo-sensitive board. If you use a 300 watt UV lamp at a distance of about 40 cm from the board and a sheet of perspex, an exposure time of 4 . . . 8 minutes should normally be sufficient.
- After exposure, remove the layout sheet (which can be used again), and rinse the board thoroughly under running water.
- After the photo-sensitive film has been developed in sodium lye (about 9 grammes of etching sodium to one litre of water), the board can be etched in ferric chloride (500 grammes of $FeCl_3$ to one litre of water). Then rinse the board (and your hands!) thoroughly under running water.
- Remove the photo-sensitive film from the copper tracks with wire wool and drill the holes.

disco phaser: oscillator board





symmetrical power supply

ative index 1983 cumulative index

983 cumulative index 1983 cumul

ative index 1983 cumulative index

In our November 1982 issue we published the design of a high-frequency generator for the lighting of model railway coaches independent of the locomotive power supply. It occurred to us that this generator could also be used for changing the headlamps to the direction of travel on double-ended locomotives.

locomotive headlamp reverser

addition to model train lighting

The generator described in our November 1982 issue superimposes a high-frequency alternating voltage (u_L) onto the direct-voltage output (U_P) of the power controller. Capacitors are used both at the output of the generator and at the input to the coach lamps to prevent the d.c. from the controller interfering with the lighting system.

The composite voltage (u_C) is applied to the input (A, B) of the reversing circuit shown in figure 1. This circuit ensures appropriate control of the reed relay in accordance with the direction of travel of the locomotive (which can, of course, be detected from the polarity of U_P). As space in model railway locomotives is restricted, all components used are, of course, miniature or sub-miniature types.

Depending upon the position of the relay contact, either La_f or La_r is connected to the input voltage, u_C, via capacitor C_L. The value of C_L is calculated from $C_L = 1/(2\pi f X_C)$ Farad, where f is the frequency of the generator (19 kHz) and X_C is the reactance of C_L. This reactance should preferably be not more than 1/5 of the value of the lamp resistance. If thus, for instance, a 12 V, 50 mA lamp is used (resistance = 240 Ω), X_C should not exceed 48 Ω and

$$C_L = 1/(2 \times 3.142 \times 19 \times 10^3 \times 48) = 175 \times 10^{-9} = 175 \text{ nF}.$$

The nearest (higher) standard value of 220 nF should thus be used.

The operating voltage for the circuit is derived from u_C. The h.f. component is rectified in diodes D1 and D2 and smoothed by capacitors C1 and C2.

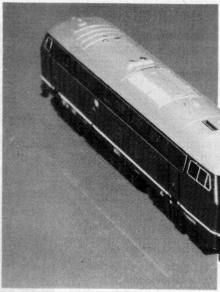
Opamp IC1 is used as a comparator: its non-inverting input lies at the centre of voltage divider R2-R3 which is connected across Up. If 'B' is positive with respect to 'A', that is, when the locomotive is reversing, capacitor C2 charges and the inverting input, pin 2, of the opamp is more negative than the non-inverting input, pin 3: the output of the comparator is then positive. Transistor T1 conducts, and the consequent voltage across zener diode D4 and voltage regulator IC2 actuates the relay. The relay operates and connects La_r to u_L.

When the locomotive goes forward again (and 'A' is positive with respect to 'B'), the voltage across C1 becomes greater than that across C2, the output of the comparator goes negative, T1 stops conducting, the relay is no longer actuated, and La_f is again connected across u_L.

Zener diode D3 is included as a high-voltage protection, but can be omitted if u_L is smaller than 35 Vpp.

The zener voltage, U_Z, of diode D4 is calculated from $U_Z = u_{Lpp} - 20$ V.

Miniature reed relays are available in DIL package and these are ideal for our purpose. If a relay with integral diode is used, D5 can, of course, be omitted. However, take note that the integral diode may be of either polarity. This should be carefully checked before wiring the relay.



1

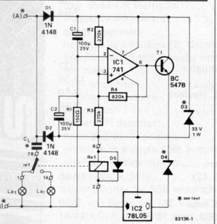


Figure 1. The circuit diagram of the locomotive headlamp reverser. Terminals A and B are the external connections across which a composite voltage (19 kHz superimposed onto the d.c. control voltage) is applied. The supply voltage for the circuit is derived from the a.c. component.

2

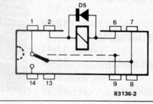
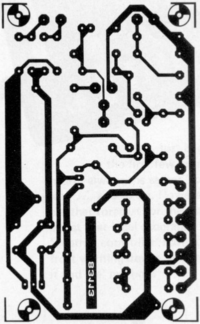


Figure 2. The internal construction and pin layout of the reed relay. In spite of their small size, many miniature relays have an integral diode.

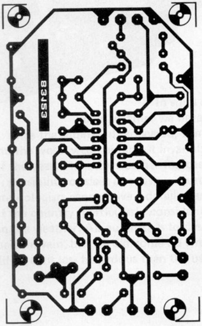
service

PC board pages

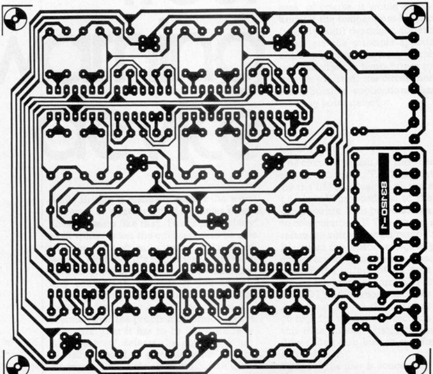
Note: the PCBs for the 64-way bus board (EPS 83102) and the marine receiver (EPS 83024) are not included since these are double-sided boards.



video amplifier



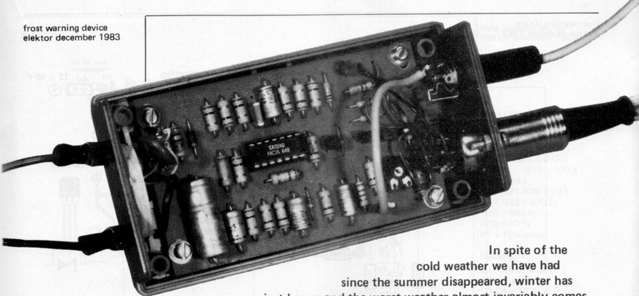
frost warning device



disco phaser: delay line board

service

PC board pages



In spite of the cold weather we have had since the summer disappeared, winter has just begun and the worst weather almost invariably comes in the first few months of the year. Then the weather forecast is nearly always the same: 'cold . . . possibility of sleet or snow . . . watch out for ice . . .', and so on. However, meteorologists cannot give a detailed an accurate weather forecast for the whole of the country, particularly considering the effect that local geography has on the weather. All our efforts to design a 'weather controller' have so far been in vain, but we did come up with this frost warning device which should be a bit less hazardous than the usual 'suck it and see' method.

frost warning device

with a memory

While Britain is normally spared the worst extremes of weather, there are times when it does not seem like that. This is particularly so in winter when the cold seems to be able to creep through any number of layers of woolen clothing. It's unpleasant, but we just have to grumble and bear it. It would be very convenient, however, if you knew before stepping outside whether it is merely 'cold' or 'very very cold'. If you have a thermometer the problem is solved, except, of course, that it has to be left outside – which sort of defeats the purpose. What is really needed is a temperature sensor mounted outside giving an indication inside. For motorists the problem is somewhat different as weather conditions can vary quite considerably in the course of a journey. Gardeners are often interested in one particular weather condition – frost. In this case, of course, it would be invaluable to know if the temperature has dropped below freezing point overnight, for example. These are the principle applications we considered for this frost warning device but, because the temperature to be detected can be adjusted, the circuit here has many more possible applications than a simple freezing-point detector.

Operation

The circuit diagram for this frost warner is shown in figure 1. The temperature is sensed by the LM 335Z which gives a specific value (A) in mV proportional to the measured temperature. This provides one of the inputs to comparator A1. The second input (B) is a reference voltage which can be adjusted with P1. When the sensor voltage at point A becomes lower than the reference voltage at point B the output of A1 goes high. This causes the oscillator around A2 to start and LED D1 flashes about once per second.
At the same time the one-shot at A3 will go high for almost two seconds and during this time a second oscillator based on A4 drives the piezo buzzer at a frequency of about 1 kHz.
As far as the user is concerned, this is what happens: when the temperature first drops

1

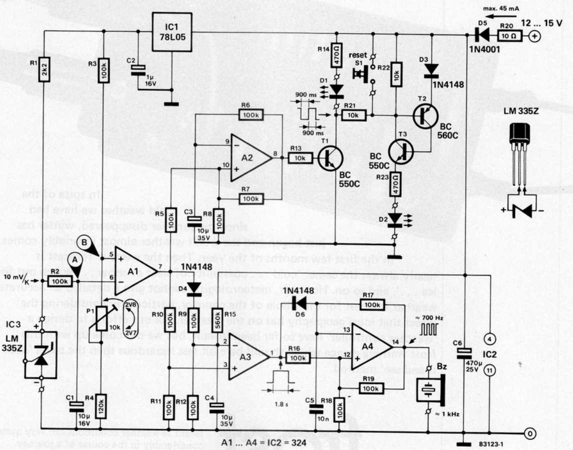
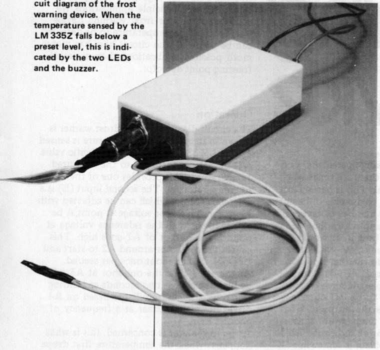


Figure 1. This is the circuit diagram of the frost warning device. When the temperature sensed by the LM 335Z falls below a preset level, this is indicated by the two LEDs and the buzzer.



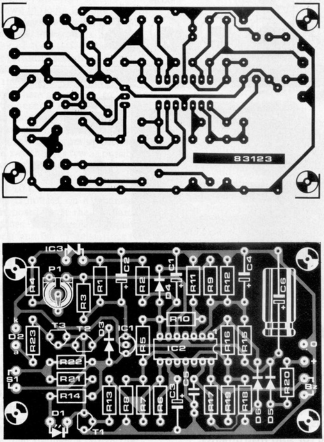
below the preset level the buzzer sounds briefly. At the same time LED D1 begins to flash and flashes until the temperature rises above the preset level again.

The circuit around T2 and T3 acts as a memory. Whenever the temperature drops below the preset level D2 lights and continues to do so even if the temperature has subsequently risen above the preset level. Push button S1 must be pressed to extinguish this LED and thus reset the memory.

Construction and adjustment

Construction should present no problems, especially if the printed circuit board layout as shown in figure 2 is used. The LM 335Z should, however, be protected from the wet, and this is quite easily done. After soldering wires onto the appropriate two leads of this sensor, the assembly can be slipped into a length of heat shrinkable tubing about ½" from the end. Heating this empty ½" will then cause it to contract and provide a waterproof seal over the device. Alternatively, the sensor could simply be sealed with two-component epoxy glue.

2



Parts list

Resistors:
R1 = 2k2
R2,R3,R5 . . . R12, R16 . . . R19 = 100 k
R4 = 120 k
R13,R21,R22 = 10 k
R14,R23 = 470 Ω
R15 = 560 k
R20 = 10 Ω
P1 = 10 k preset

Capacitors:
C1 = 10 μ/16 V
C2 = 1 μ/16 V
C3,C4 = 10 μ/35 V
C5 = 10 n
C6 = 470 μ/25 V

Semiconductors:
D1,D2 = LED
D3,D4,D6 = 1N4148
D5 = 1N4001
T1,T3 = BC 550C
T2 = BC 560C
IC1 = 78L05
IC2 = 324
IC3 = LM 335Z

Miscellaneous:
Bz = piezo buzzer (Toko PB 2720)
S1 = push to make pushbutton
Case, dimensions 120 x 65 x 65

Figure 2. This is the printed circuit board layout for the circuit showing where all the components are mounted.

A mixture of crushed ice and water is needed to adjust the circuit. Stirring the mixture with the sensor for a minute or two will cause the sensor to be at freezing point. Potentiometer P1 is then adjusted until LED D1 just lights and the buzzer sounds briefly. Some people may consider this as a case of shutting the stable door after the horse has bolted as freezing can occur at any temperature below about +3°C. However, if a thermometer is used as a reference, this temperature could just as easily be used as the preset value.

The maximum current consumption of the circuit is about 45 mA, and with its supply voltage of 12 . . . 15 V it can be powered by a car battery. If it is to be used in the home a suitable power supply will have to be added, of course. ◼

Even though this circuit may seem eminently suitable for use in a car as an ice warning device, there are a few problems to be considered first. The sensor would have to be mounted somewhere out of the air stream but where it is not affected by engine (or cabin) heat. Even if your car has a suitable mounting location, this will still leave the sensor several inches above the road (which is where the sensor really should be). Also temperature is not the only factor affecting the formation of ice and just measuring one parameter cannot be considered as a reliable indication. It is rather doubtful, therefore, whether any so-called frost warning device is of any use in a car. However, if you are going on a long journey the weather (and road) conditions may change a lot, so if your frost warner starts to flash before you are half way to your destination then at least you know you should be on your guard!

disco phaser

Phasing is an effect well known to musicians. In electronic parlance it is, in fact, a comb filter so called because the response is the attenution and amplification of a number of equally spaced frequencies in the audio spectrum. It lends itself particularly well to sounds rich in harmonics and is therefore ideal for use with recordings, musicassettes, or records containing much percussion, E-string guitar music, or choral works; it is not really suitable for solo instruments.

comb filter with switched resistors

The filter response which provides the phasing effect is illustrated in figure 1. From this it is easy to see why it is called a comb filter. There are a number of ways in which this can be achieved in practical terms. Studio quality systems can be very complex and therefore very expensive, but simpler methods do exist and, while not giving hi-fi performance, do give a reasonable sound quality. The easiest method, which is incidentally the method used by virtually all low-cost commercial phasers, is to use a string of wide-band filters. These form a delay line with a delay which can normally be varied between 1 and 15 ms. To be sure, quite a number of electronic switches are required, but the use of TL 084 JFET opamps and 4066 quad bilateral switches keeps the number of components to a minimum. Moreover, the circuit needs no

1

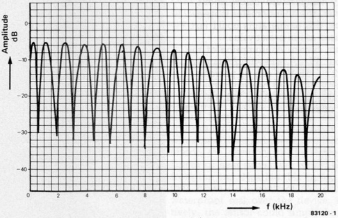


Figure 1. Frequency response of a phaser. The typical comb shape is the result of the amplification or attenuation of certain frequencies. By modulating the clock output, the 'teeth' are stretched and compressed like a concertina.

calibration, it accepts all signals of which the level lies between the two supply voltages, it produces neither noise nor distortion, and it requires no low-pass filters.
The circuit shown in figure 2 is one element of the 16-stage delay line used in the phaser. With the type of filter used, it is, perhaps, better to speak of time shift rather than phase shift. It is readily seen from figure 2 how this shift is achieved: the larger capacitor C, the greater the time shift. Unfortunately, there's a limit to this, because the frequency response of the filter tends to narrow with increasing C. The only way to reconcile these two incompatible factors is a compromise between the number of switches (as few as possible!) and the sound quality (good transfer characteristic). We found that values of C = 4n7 and R1 . . . 3 = 10 k gave the best results.
The delay line is housed on a separate printed-circuit board from the oscillator and control stages. This arrangement makes it possible for a number of delay lines to be connected in series or for the delay line to be used for purpose other than described here.
Coupling capacitors C17 . . . 19 are necessary at the audio input and delay outputs 1 and 2 to prevent d.c. entering, or off-set voltages produced by the many opamps leaving, the delay line.
It is, of course, vital that the delay line is adjustable and the various means by which this can be achieved include OTAs (operational transconductance amplifiers), FETs (field-effect transistors), and so on. It is, however, much cheaper to switch resistors by means of CMOS switches which open and close (under the control of the clock generator, N1) at a high frequency. When the switch is open, the flow of current is interrupted and the associated capacitor does not charge. When the switch is closed, current flows and the capacitor charges. The switching frequency is of little concern in this application: what is important is how long the switch is open or closed as this determines the length of pulses and pauses. Ideally, the duty cycle (that is, the pulse/pause ratio) should be continuously variable between 0 and 100 per cent, and all switches should be controlled by the same clock. The clock frequency should preferably be more than twice the highest audio frequency, say, 40 . . . 50 kHz. Be careful when using tape recorders, however, as the erase oscillator may work at the about the same frequency.

Oscillator

As stated, we need a pulse-width (clock) generator which produces square waves at a frequency of about 40 . . . 50 kHz: this is Schmitt trigger N1 and associated components (see figure 3b). The square-wave pulses are converted by low-pass filter R12-C6 into a triangular wave form which is then fed to opamp IC5. This IC functions as a comparator and its trigger level is determined by the voltage at its non-inverting input (pin 3). The pulse width at the output (pin 6) of IC5 is also directly dependent upon the voltage at pin 3. Schmitt trigger N2 merely restores the output pulses to square waves.

2

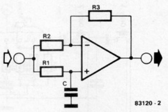


Figure 2. Basic circuit of a wide-band filter: the delay is determined by C and R1.

As we said before, it must be possible to vary the pulse-width at the output of N2, and this can be done in two ways: manually, with P3, and by means of an LFO (low-frequency oscillator) consisting of integrator A1 and trigger A2.
As the phasing effect sounds better if the pulse-width is modulated by a sine wave rather than a triangular wave, buffer A3 and limiting diodes D5 and D6 are connected in series with the (triangular) output of the LFO. The output level of the LFO is about ± 0.7 V which can be set to any value within this range by means of P2. The output of the LFO stages is taken across R18 to A4 (pin 13) where it is mixed with the voltage from P3. The relation between these two inputs is determined by the trigger level of the mixer which is set by P3.
It may, unfortunately, happen that the presetting range of P2 and P3 includes an area where the output voltage of A4 is too low or too high. This results in IC5 clipping the triangular wave form at pin 2 (see figure 4), which causes a loud click in the loudspeaker. This trouble is encountered particularly when the pulse width is set too narrow (duty cycle below about 2 or 3 per cent).
A control stage is therefore needed to limit the output of A4. A Schmitt trigger, N3, is triggered by the output signal of IC5 (which has a variable duty cycle) and functions as a secondary clock generator: its output is inverted by N4. The outputs of N3 and N4 are integrated and converted into d.c. voltages which are compared with a reference voltage by IC1 and IC2 respectively. The reference voltages are preset by P5 and P6 respectively. The d.c. levels (which are thus proportional to the duty cycle) are used to control A4 so that the output of this stage cannot exceed a duty cycle range of 10 . . . 90 per cent (see figure 4). An incidental advantage of this arrangement is that the control stage is independent of the clock generator and the low-frequency oscillator. If necessary, it can therefore be disconnected from A4 without any ill effect.

Additional points

The delay time of the sixteen-element delay line is 6 ms. The delay time can, of course, be lengthened by connecting a number of delay lines in series. However, we found that when more than two lines are used, the sound becomes increasingly distorted and the overall effect is one of impairment rather than improvement.

3

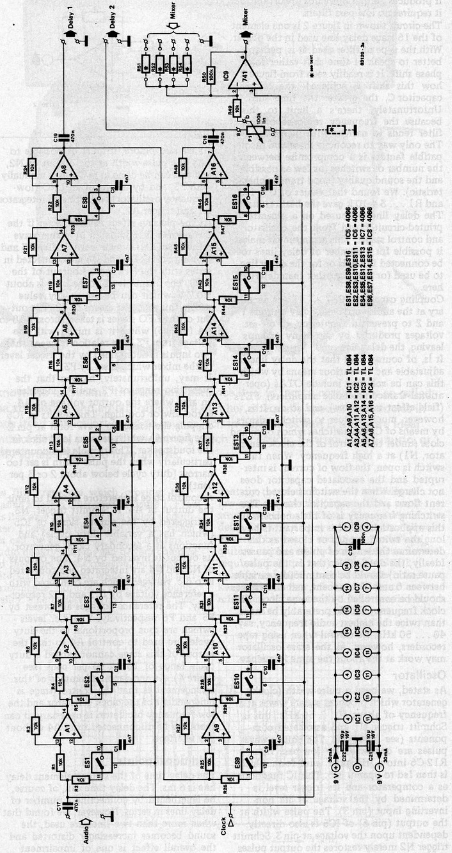


Figure 3a. The circuit diagram of the sixteen active filters and the (electronically) switched input resistors which form the delay line.

3

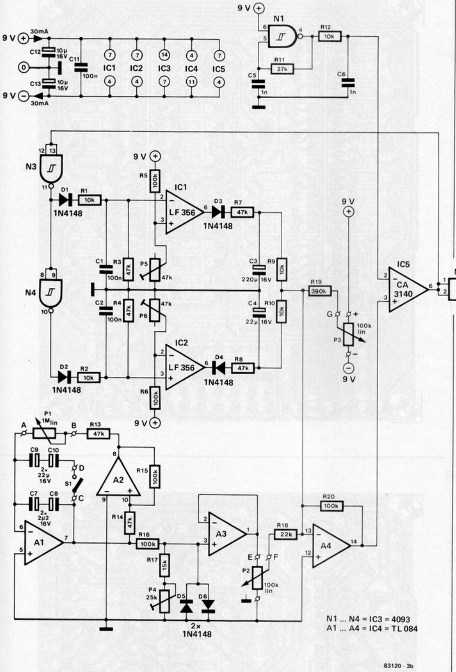


Figure 3b. The circuit diagram of the oscillator and control stages.

4

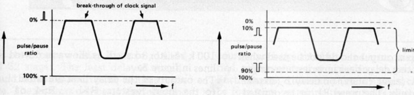


Figure 4. The most likely fault is the breaking through of the clock signal when the pulse/pause ratio becomes too large or too small. The control stage limits the ratio.

Parts list — delay line

Resistors:
R1 . . . R49 = 10 k
R50 = 100 k
P1 = 100 k linear preset

Capacitors:
C1 . . . C16 = 4n7 ceramic
C17 . . . C19 = 470 n ceramic
C20 = 100 n ceramic
C21,C22 = 10 μ/16 V electrolytic

Semiconductors:
IC1 . . . IC4 = TL 084
IC5 . . . IC8 = 4066
IC9 = 741

Miscellaneous:
printed-circuit board 83120-1

Parts list — oscillator

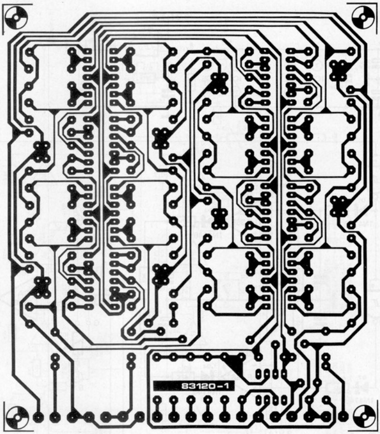
Resistors:
R1,R2,R9,R10,R12 = 10 k
R3,R4,R13,R14 = 47 k
R5,R6,R15,R16, R20 = 100 k
R7,R8 = 47 k
R11 = 27 k
R17 = 15 k
R18 = 22 k
R19 = 390 k
P1 = 1 M linear preset
P2,P3 = 100 k linear preset
P4 = 25 k preset
P5,P6 = 47 k preset

Capacitors:
C1,C2,C11 = 100 n ceramic
C3 = 220 μ/16 V electrolytic
C4,C9,C10 = 22 μ/16 V electrolytic
C5,C6 = 1 n ceramic
C7,C8 = 2μ2/16 V electrolytic
C12,C13 = 10 μ/16 V electrolytic

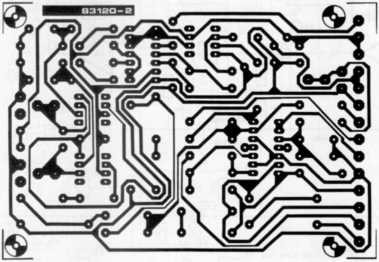
Semiconductors:
D1 . . . D6 = 1N4148
IC1,IC2 = LF 356
IC3 = 4093
IC4 = TL 084
IC5 = 3140

Miscellaneous:
S1 = SPST switch
Printed-circuit board 83120-2

5



6



The mixer output should not be used when connecting delay lines in series: use output delay 1 (eight filters) or delay 2 (sixteen filters) only. The preset P1 can be omitted from all but the last in a series of delay lines, but it must then be replaced by a 100 k resistor to earth as shown in dotted lines in figure 3a.
The outputs of the delay lines are wired to the input resistors, R51 . . . R54, of mixer IC9. Four inputs are provided to enable two delay lines to be wired in series.

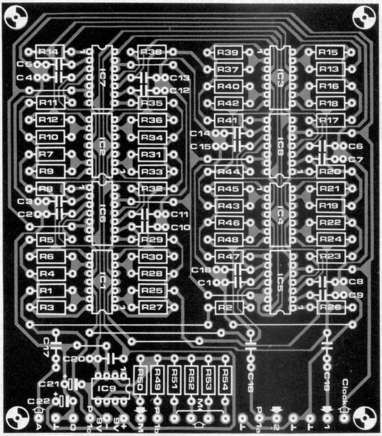


Figure 5. Layout and trackside of the printed-circuit board for the delay line: provision is made for resistors R51 . . . 54.

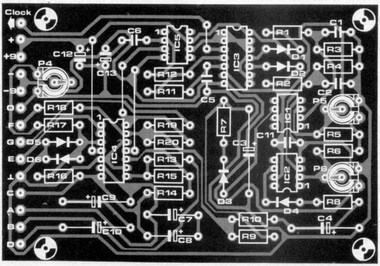


Figure 6. Layout and trackside of the printed-circuit board for the oscillator and control stages.

This then forms a delay line of 8, 16, 24, and 32 stages. The least delayed sound should be connected to the highest resistance. The resistors can be of the following values: 1 M (R51), 470 k (R52), 220 k (R53), 100 k (R54). These values are, of course, entirely arbitrary and you may find other values more pleasing to you. Furthermore, different phasing effects can be found by switching the outputs of the delay lines to the mixer. ◄

One of the most interesting characteristics of combining a BASIC compiler with a Disk Operating System is the possibility of creating data files accessed by one or more programs written in BASIC. For Junior Computer owners the procedure is described briefly in the Ohio notes, but when this banking program was sent in by a reader we saw it as an excellent opportunity to delve a bit deeper into the operation of indirect files.

banking program

a financial control program using indirect filing on the Junior Computer

L. Germain

Before we start in earnest it is important to note the difference between direct and indirect files. If a programmer writes a program with line numbers, he has direct access while he is editing, modifying and listing it. When this same program generates data due to calculations, compiles the results and makes a new ('data') file saved on disk under another name using the OPEN, CLOSE, GET and PUT instructions, this is known as indirect access. In effect, the user cannot add to, remove from, or even inspect the data directly in this file.

How to prepare indirect files

As a general rule the first task is to assign names to the files. In our example, these are 'DATA2' and 'DATA3', which are the indirect files, 'BANK', which is the main program and 'PRPDA3' (for 'prepare DATA3'). 'DATA3' is an indirect random file which is only used to save the total of the count, the number of the last operation (these are both initialised automatically by 'PRPDA3') and a security code to refuse access to anybody who does not know it (if the RUN at the end of line 45 of 'BANK' is replaced by NEW the program automatically erases itself if the code is wrong). The instruction POKE 741,10 could also be included at the start of line 20 of 'BANK' to prevent the program from being listed.

'DATA2' contains the financial operations (amounts, date and nature) registered by the program 'BANK'. Before storing the programs 'BANK' and 'PRPDA3' in memory, buffer zones must be created using option 7 of BEXEC*. Two buffers are needed for 'BANK' ('DATA2' and 'DATA3') and a single one for 'PRPDA3'. Initially four tracks of diskette could be reserved for 'BANK', one for 'DATA3', one for 'PRPDA3' and at least ten for 'DATA2' (enough for about a year's use). When all of table 1 has been saved on diskette, 'PRPDA3' must be run, a code entered, and then 'BANK' run. When the correct code has been entered, the screen will then display the eight options available to the user.

The routines used

At the start of each of the specific routines the program will seek two fundamental data values on the diskette: the remaining balance (variable S) and the number of the last operation specified (variable C). This is done starting at line 500. The subroutine at line 525 reverses the procedure at the end of each routine.

Input and output routines

The program first asks the number of credits or debits to be processed. Then it requests the amount of the first operation, its nature (or category) and its date.

The date is always indicated by six figures, first the day, then the month and finally the year, with two numbers for each. The category is registered as a string of characters, so it could consist of names ('taxes' for example), numbers (such as cheques) or abbreviations.

Request routine

It is possible to get a complete list of all credits or debits, or a listing per month or even of a certain operation (identified by amount, category and date). If one or two of the required parameters are not known (amount/category/date) write 'X'.

Balance routine

This routine displays the balance available.

Adding routines

As the name implies, these options are used for compiling totals for the different types of operations.

When the program is used for the first time, option '1' must be used to register at least one credit, otherwise the program will refuse all attempts to get it to work. As it would take far too much space to deal with all the various details of this program, we will have to be content with the bare minimum, so we will go no further. We are sure that any interested readers will make short work of sorting out this program and will use nothing but indirect files from now on. ◼

Table 1. Program PRPDA3 is only used for entering the (secret) security code into file DATA3.

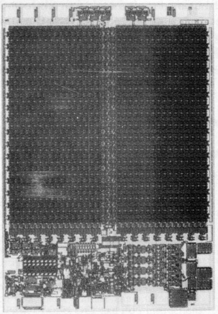
Table 1

```
5 REM PRPDA3
10 PRINT:PRINT:INPUT"INPUT CODE ";B$:C=0:S=0
20 DISK OPEN,6,"DATA3":DISK GET,1
30 PRINT§6,1;",";B$:DISK PUT:DISK GET,2
40 PRINT§6,2;",";C;",";S:DISK PUT: DISK CLOSE,6
```

Table 2

```
1 REM BANK
5 PRINT:PRINT:PRINT:POKE 2888,0:POKE8722,0
10 PRINTTAB(16)"*FINANCIAL CONTROL PROGRAM*":PRINT:PRINT
20 PRINT:PRINT:INPUT"CODE ";A$:PRINT:PRINT
30 DISK OPEN,6,"DATA3":DISK GET,1
45 INPUT §6,R,B$:DISK CLOSE,6:IFA$<>B$ THEN RUN
70 CLEAR:PRINT:PRINTTAB(3)"1 = CREDITS"
80 PRINTTAB(3)"2 = DEBITS"
90 PRINTTAB(3)"3 = REQUESTS"
95 PRINTTAB(3)"4 = BALANCE"
96 PRINTTAB(3)"5 = MONTHLY TOTAL"
97 PRINTTAB(3)"6 = ANNUAL TOTAL"
98 PRINTTAB(3)"7 = TOTAL PER CATEGORY"
100 PRINTTAB(3)"8 = EXIT"
105 PRINT:INPUT"NUMBER SELECTED ";A
110 ON A GOTO 130,200,250,330,340,380,430,1000
120 GOTO70
121 REM
130 GOSUB500:PRINT:PRINT:PRINTTAB(16)"CREDIT ROUTINE"
145 PRINT:PRINT:INPUT"NUMBER OF CREDITS";D:PRINT:PRINT
150 DISK OPEN,6,"DATA2"
155 FOR R=C+1 TO C+D
160 INPUT"AMOUNT ";E:S=S+E:PRINT:PRINT
161 INPUT"OPERATION OR CATEGORY ";A$:PRINT:PRINT
170 INPUT"DATE (DAY/MONTH/YEAR) ";B$:S$="C":PRINT:PRINT:DISK GET,R
180 PRINT§6,R;",";E;",";A$;",";B$;",";S$
185 DISK PUT:NEXTR:C=R-1:GOSUB525:GOTO70
186 REM
200 GOSUB500:S$="D":PRINT:PRINT:PRINTTAB(16)"DEBIT ROUTINE":PRINT:PRINT
205 DISK OPEN,6,"DATA2":INPUT"NUMBER OF DEBITS ";B:PRINT:PRINT
215 FOR R=C+1 TO C+B
220 INPUT"AMOUNT ";E:PRINT:PRINT
221 IF(S-E)<OTHEN PRINT"YOU ONLY HAVE ";S;" POUNDS!":PRINT:PRINT:GOTO220
225 S=S-E
226 INPUT"OPERATION OR CATEGORY ";A$:PRINT:PRINT
227 INPUT"DATE (DAY/MONTH/YEAR) ";B$:PRINT:PRINT
235 DISK GET,R:PRINT§6,R;",";E;",";A$;",";B$;",";S$
240 DISK PUT:NEXTR:DISK CLOSE,6:GOSUB525:GOTO70
241 REM
250 PRINT:PRINTTAB(16)"REQUEST ROUTINE":PRINT:PRINT
255 PRINT"DO YOU WANT TO LOOK AT ";
256 INPUT"CREDITS OR DEBITS (C/D) ";Z$:PRINT:PRINT
260 INPUT"DO YOU WANT A LIST (Y/N) ";X$:IF X$<>"Y" THEN 265:PRINT:PRINT
262 INPUT"DO YOU WANT A LIST PER MONTH (Y/N)";H$:PRINT:PRINT:IF H$<>"Y"THEN280
263 GOSUB 500:GOSUB 710:V$=Z$:GOTO345
265 PRINT:PRINT:INPUT"AMOUNT ";I$:PRINT:PRINT:IF I$<>"X" THEN 280
270 INPUT"OPERATION OR CATEGORY ";I$:PRINT:PRINT
271 IF I$<>"X" THEN 280
275 INPUT"DATE ";I$:IF I$="X" THENPRINT:PRINT"IMPOSSIBLE REQUEST !!":GOTO70
276 REM
280 GOSUB 500:DISK OPEN,6,"DATA2"
285 FOR R=1 TO C:DISK GET,R
290 INPUT§6,R,E,A$,B$,S$:IF Z$<>S$ THEN 320
295 IF X$="Y" THEN GOSUB600:GOTO 320
296 REM
300 IF I$=A$ OR I$=B$ OR E=VAL(I$) THEN GOSUB 600
320 IF W=15 THEN INPUT"CR TO CONTINUE ";W$:W=0
321 NEXTR:IF Y=0 THEN PRINT:PRINT"DATA NOT FOUND "
322 DISK CLOSE,6:Y=0
323 PRINT:PRINT:INPUT"CR TO CONTINUE ";W$:GOTO70
324 REM
330 GOSUB500:PRINT:PRINT:PRINT"BALANCE :";S;" POUNDS":GOTO 323
331 REM
340 X$=" MONTH ":GOSUB700
345 PRINT:PRINT:INPUT"MONTH ";M:DISK OPEN,6,"DATA2"
355 FOR R=1 TO C:DISK GET,R
357 INPUT §6,R,E,A$,B$,S$
360 IF V$<>S$ THEN 365
361 L=VAL(MID$(B$,4,2)):O=VAL(RIGHT$(B$,2))
363 IF H$="Y" AND Q=O AND M=L THEN GOSUB600:IF W=18 THEN 320
364 IF Q=O AND M=L THEN LET T=T+E
365 NEXTR
370 PRINT:PRINT:PRINT"TOTAL OF ";V$;" FOR ";M;"/";Q;" : ";T;" POUNDS "
371 T=0:Q=0
375 GOTO 323
376 REM
380 X$="YEAR ":GOSUB700:DISK OPEN,6,"DATA2"
400 FOR R=1 TO C:DISK GET,R
410 INPUT §6,R,E,A$,B$,S$
415 IF V$<>S$ THEN 425
420 O=VAL(RIGHT$(B$,2))
422 IF Q=O THEN LET T=T+E
425 NEXTR
427 PRINT:PRINT:PRINT"TOTAL OF ";V$;" FOR ";Q;" : ";T;" POUNDS":T=0:GOTO 323
428 REM
430 X$=" CATEGORY ":GOSUB700:PRINT:PRINT:INPUT"CATEGORY ";I$
435 DISK OPEN,6,"DATA2"
440 FOR R=1 TO C:DISK GET,R:INPUT §6,R,E,A$,B$,S$
442 IF V$<>S$ THEN 450
444 L=VAL(RIGHT$(B$,2)):IF Q=L AND A$=I$ THEN LET T=T+E
450 NEXTR
455 PRINT:PRINT:PRINT"TOTAL OF ";I$;" FOR ";Q;" = ";T;" POUNDS":T=0:GOTO323
456 REM
500 DISK OPEN,6,"DATA3"
510 DISK GET,2:INPUT §6,R,C,S:DISK CLOSE,6:RETURN
524 REM
525 C=R-1:DISK OPEN,6,"DATA3":DISK GET,2:PRINT§6,2;",";C;",";S
540 DISK PUT:DISK CLOSE,6:RETURN
550 REM
600 IF LEN(STR$(E))=9 THEN SP=0:GOTO 620
602 K=LEN(STR$(E)):SP=(9-K)
620 PRINT R;TAB(4)"AMOUNT :";SPC(SP);E;"Pds /OPER. OR CAT. ";A$;
621 PRINTTAB(49)"DATE:";B$;" ";S$
630 W=W+1: Y=Y+1:RETURN
700 GOSUB 500:PRINT:PRINT"ADDING ROUTINE PER ";X$
705 PRINT:PRINT:INPUT"CREDITS OR DEBITS (C/D) ";V$
710 PRINT:PRINT:INPUT"YEAR ";Q:RETURN
1000 END
```

Table 2. The banking program proper (BANK) works with two random access files DATA2 and DATA3 for which two buffers must be created after entering the instructions here.



NOVRAM:

data storage without batteries

Semiconductor manufacturers are at present investing large amounts of time (and money) into developing non-volatile memories, whereby the data is saved even in the case of the power being removed. These devices are finally about to hit the market, and the manufacturer is very confident about their success.
There is no questioning the need for non-volatile memories. Every computer user would like to be sure that his memory storage is safeguarded if the power unexpectedly fails. And how about the digital tuner in some hi-fi systems which fail to remember the transmitter frequencies if the power supply is cut off for too long? So NOVRAMs are definitely not of the 'invent them first and find a use for them later' school of electronics.

The CMOS RAM could be considered the forerunner of the true non-volatile memory. It is noted for its very low quiescent current consumption, so that the data in the memory can be saved for months or even years with batteries providing the power. This is not a completely satisfactory solution, of course, but it is handy as far as it goes.
In the last few years some proper non-volatile memories have appeared, notably the EAROM (Electrically Alterable ROM) and the EEPROM (Electrically Erasable PROM). These are ROMs whose contents can be altered electrically, without the device first having to be erased by exposure to UV light, for example. An extra programming voltage is often required, but in the newest types even that is unnecessary as a 'high voltage' generator is integrated in the chip. A single voltage of 5 V is all that is needed.
The biggest disadvantage of all these electrically rewritable ROMs is the long time needed to write to them. Normally it takes about 10 ms per byte, which is very slow, compared to the few hundred nanoseconds for a normal RAM. This means that an EAROM or EEPROM is no real substitute for a RAM. A further point to remember is that these ROMs can only be 'rewritten' a certain number of times, normally about 10 000. An EAROM or EEPROM is thus entirely suitable as a transmitter memory in a tuner, for example, but its application in computers is limited.

The NOVRAM

The new NOVRAM (NOn-Volatile RAM) from the Californian firm of Xicor is finally a step in the right direction. This IC combines the advantages of the normal RAM and the electrically rewritable ROM. At the moment the NOVRAM is available in three versions: 1 K x 1 bit, 64 x 4 bit and 256 x 4 bit. The pin designations of the three types are shown in figure 1. All inputs and outputs are fully TTL compatible and only one supply voltage of 5 V is needed.
A block diagram of the NOVRAM is shown in figure 2. From this it appears that the layout is practically the same as a normal static RAM. We see that it has normal address and data lines plus a $\overline{\text{CS}}$ and $\overline{\text{WE}}$ input. The actual memory is doubled: each RAM memory location has an EEPROM counterpart. This means that each IC contains not one but two memory matrices laid one over the other. Data transfer between the two memories is controlled using two extra inputs, $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$. Giving a pulse at the $\overline{\text{STORE}}$ input causes the IC to duplicate the total content of the RAM into the EEPROM. The IC needs a maximum of 10 ms to complete this whole duplication! If a pulse is given at the $\overline{\text{RECALL}}$ input the contents of the EEPROM is written back to RAM. The time taken for this operation is about 1 ms.

This set up gives several important advantages. For normal use (as RAM memory in a computer system, for example) the NOVRAM can simply act as a normal memory and the computer does not have to take long write-times into account. When

1

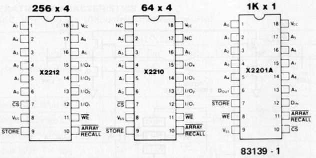


Figure 1. The pin designations of the three NOVRAMs at present available.

2

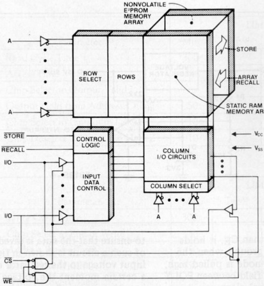


Figure 2. This block diagram shows the layout of the NOVRAM. The memory section is doubled, so it consists of RAM and EEPROM sections.

the power is switched off or fails, a single pulse is enough to store all the data in the EEPROM. In this way important data can be saved for an indeterminate time without the need for auxiliary supplies. Even though the NOVRAM suffers partly from the EPROM disadvantage of needing a certain number of write cycles, this is rarely a problem. The RAM section can be written to and read from freely. The data only needs to be written to the EEPROM section when the power is to be switched off.

The technology

The Xicor NOVRAMs use FETs with floating gates. A floating gate is an island of polysilicon surrounded by oxides. A charge can be induced on, or removed from, the gate by applying a sufficiently strong electric field to cause electron tunneling through the oxides. Under normal conditions the charge remains constant on the gates even when the power is removed. The NOVRAM uses three layers of polysilicon, the centre one being the floating gate.

The diagram of figure 3 shows one single data cell of a NOVRAM. The RAM section consists of a conventional six transistor structure, while the EEPROM section consists of the three polysilicon layers and two FETs to control the data transfer. The floating gate (POLY 2) is only connected to the rest of the circuit through capacitance. POLY 2 is charged by transferring electrons to it from POLY 1, and discharged by transferring these electrons to POLY 3. The key to the operation is in the ratios between capacitances CC2, CC3, C_E and C_P. When writing from RAM to EEPROM the sequence is as follows. If node N1 is low, transistor Q7 is turned off so the junction between CC2 and CC3 floats. As the total capacitance of CC2 + CC3 is larger than Cp the floating gate follows the Internal Store Voltage node. If the voltage on the floating gate is high enough electrons are tunneled from POLY 1 to POLY 2 so that the floating gate is negatively charged.
If node N1 is high, Q7 is turned on thus grounding the junction between CC2 and

3

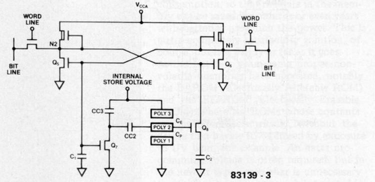


Figure 3. Here we see a single memory cell. The RAM section consists of the upper part, while the lower area is the EEPROM cell.

4

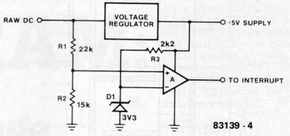


Figure 4. This circuit is used to detect any failure of the power supply and it then gives a $\overline{\text{STORE}}$ pulse to the NOVRAM.

CC3. As CC2 is larger than C_E, it holds the floating gate near ground when the Internal Store Voltage node is pulled high. This causes a sufficient field between POLY 2 and POLY 3 to tunnel electrons away from the floating gate to leave it with a positive charge.

The RECALL operation also takes advantage of capacitance ratios, in particular that C2 is larger than C1. When the external RECALL command is received, the internal power supply, V_{CCA} is first pulled low to make the voltage at N1 and N2 equal. Then the supply rises again and the node with the lesser capacitance rises more rapidly than the other, and is then latched high by the flip-flop. If the floating gate has a positive charge, N2 is connected to C2 via Q8 and will latch low. If the floating gate has a negative charge, Q8 is turned off and N1 will thus latch low.

How a NOVRAM is used

Nothing needs to be said about connecting up the NOVRAM as this is almost the same as for a normal RAM. The only signals which are different are the $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$. The $\overline{\text{RECALL}}$ pulse can be taken care of by the software in the computer. The $\overline{\text{STORE}}$ signal on the other hand can better be generated by a separate circuit. This circuit watches for power failures and, if one is detected, supplies a pulse to the NOVRAM to ensure that the data is saved. An example of such a circuit is shown in figure 4. If the input voltage to the regulator drops, then at a certain moment the voltage at the non-inverting input of comparator A will be lower than the reference voltage at the inverting input. The output voltage then drops from +5 V to zero. This transition can be used to trigger the $\overline{\text{STORE}}$ pulse. The circuit reacts at an input voltage of about 8 V. It should be remembered that the 5 volts must remain present for at least 10 ms after the input voltage has dropped below 8 V. This is the time needed by the NOVRAM to transfer data from RAM to EEPROM. The values of the supply capacitors should be made to suit this.

This NOVRAM is quite an interesting IC, but, of course, every silver lining has a cloud, and in this case it is the higher price than 'normal' memories and probably the difficulty of getting hold of them. However, this is bound to change!

Literature:
Xicor application notes AN 101 . . . 103
Xicor NOVRAM Memories data sheet.
Xicor's U.K. suppliers are:
Micro Call Ltd.
Thame Park Road
Thame
Oxon OX9 3XD
Telephone: 08442 15405

D.C. AND OPERATING CHARACTERISTICS
T_A = 0°C to 70°C, V_{CC} = +5 V ± 10%, unless otherwise specified.

Symbol	Parameter	X2212/X2201A Min	X2212/X2201A Typ(1)	X2212/X2201A Max	X2210 Min	X2210 Typ(1)	X2210 Max	Units	Test Conditions
I_{CC}	Power Supply Current		40	60		35	50	mA	All Inputs = 5.5V, $I_{I/O}$ = 0mA, T_A = 0°C
I_{LI}	Input Load Current		.1	10		.1	10	μA	V_{IN} = GND to 5.5V
I_{LO}	Output Leakage Current		.1	10		.1	10	μA	V_{OUT} = GND to 5.5V
V_{IL}	Input Low Voltage	−1.0		.8	−1.0		.8	V	
V_{IH}	Input High Voltage	2.0		V_{CC}	2.0		V_{CC}	V	
V_{OL}	Output Low Voltage			.4			.4	V	I_{OL} = 4.2mA
V_{OH}	Output High Voltage	2.4			2.4			V	I_{OH} = −2mA

A.C. CHARACTERISTICS
T_A = 0°C to 70°C, V_{CC} = +5 V ± 10%, unless otherwise specified.

READ CYCLE

Symbol	Parameter	LIMITS Min	LIMITS Typ(3)	LIMITS Max	Units
t_{RC}	Read Cycle Time	300			ns
t_A	Access Time			300	ns
t_{CO}	Chip Select to Output Valid			200	ns
t_{OH}	Output Hold from Address Change	50			ns
t_{LZ}	Chip Select to Output in Low Z	10			ns
t_{HZ}	Chip Deselect to Output in High Z	10		100	ns

WRITE CYCLE

Symbol	Parameter	LIMITS Min	LIMITS Typ(3)	LIMITS Max	Units
t_{WC}	Write Cycle Time	300			ns
t_{CW}	Chip Select to End of Write	150			ns
t_{AS}	Address Set-up Time	50			ns
t_{WP}	Write Pulse Width	150			ns
t_{WR}	Write Recovery Time	25			ns
t_{DW}	Data Valid to End of Write	100			ns
t_{DH}	Data Hold Time	0			ns
t_{WZ}	Write Enable to Output in High Z	10		100	ns
t_{OW}	Output Active from End of Write	10			ns

Note: typical values are stated for T_A = 25°C and nominal supply voltages

STORE CYCLE

Symbol	Parameter	LIMITS Min	LIMITS Typ(3)	LIMITS Max	Units
t_{ST}	Store Time			10	ms
t_{STP}	Store Pulse Width	100			ns
t_{STZ}	Store to Output in High Z			100	ns
t_{OST}	Output Active from End of Store	10			ns

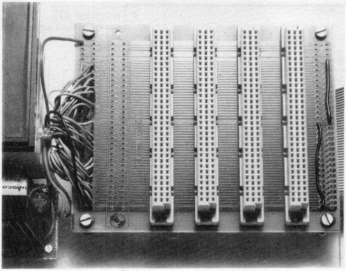
ARRAY RECALL CYCLE

Symbol	Parameter	LIMITS Min	LIMITS Typ(3)	LIMITS Max	Units
t_{RCC}	Array Recall Cycle Time	1200	1000		ns
t_{RCP}	Recall Pulse Width	450			ns
t_{RCZ}	Recall to Output in High Z			100	ns
t_{ORC}	Output Active from End of Recall	10			ns
t_{ARC}	Recalled Data Access Time from End of Recall			750	ns

ABSOLUTE MAXIMUM RATINGS

Temperature Under Bias −10°C to +85°C
Storage Temperature −65°C to +125°C
Voltage on Any Pin with Respect to Ground −1.0 V to +6 V
D.C. Output Current 5 mA

Table 1. The technical specifications of the NOVRAM.



What TRS-80, LNW 80, Video-Genie, Atom, Junior Computer, Ohio owner has never dreamed of being able to connect some specialized circuit to his computer? And what about a design borrowed from another member of his micro computer club? Just think of the possibilities that opens up. That would have to be very complicated, you say. Not necessarily . . . read on and find out more.

bus extension

for the TRS-80 and other personal computers

It is no secret to anybody that there is a price war raging in the market for home computers. Every manufacturer tries to establish as wide a range as possible in order to sell the maximum number of extensions (their prices have fallen also, but not to the same extent as the actual computers). This can make it difficult to connect peripherals to a computer without having to buy as many connectors and cables as circuits. When we came up against this problem we decided it was time to see how the Elektor bus board could be used with other (non-Elektor) equipment.

Many specialized shops (and magazines) supply all sorts of different equipment, and

Table 1

ACORN ATOM	TRS 80 MI LNW 80/I Vidéo Genie I/II	6809	Z80	6502	SC/MP INS 8060 INS 8070	(seen from below) c b a	SC/MP INS 8060 INS 8070	6502	Z80	6809	TRS 80 MI LNW 80/I Vidéo Genie I/II	ACORN ATOM
+5 V	+5 V	+5 V	+5 V	+5 V	+5 V	1	+5 V	+5 V	+5 V	+5 V	+5 V	+5 V
NC	NC	NC	NC	NC	ØEØØ-ØFFF 1)	2	Ø6ØØ-Ø7FF 1)	NC	NC	NC	NC	$\overline{\text{BLKØ}}$
	(−12 V)	−12 V	−12 V	−12 V	−12 V	3	−12 V	−12 V	−12 V	−12 V	(−12 V)	(−12 V)
⊥	⊥	⊥	⊥	⊥	⊥	4	⊥	⊥	⊥	⊥	⊥	⊥
RDY	$\overline{\text{WAIT}}$	MRDY	$\overline{\text{WAITEX}}$	RDY	N HOLD	5	NRST	RES	$\overline{\text{PWCL}}$	$\overline{\text{RESET}}$	$\overline{\text{SYSRES}}$	NRST
NC	NC	NC	NC	NC	Ø8ØØ-Ø9FF 1)	6	NBREQ	NC	NC	$\overline{\text{DMA/BREQ}}$	NC	NC
DØ	DBØØ	DBØØ	DBØØ	DBØØ	DBØØ	7	DBØ1	DBØ1	DBØ1	DBØ1	DBØ1	D1
D2	DBØ2	DBØ2	DBØ2	DBØ2	DBØ2	8	DBØ3	DBØ3	DBØ3	DBØ3	DBØ3	D3
D4	DBØ4	DBØ4	DBØ4	DBØ4	DBØ4	9	DBØ5	DBØ5	DBØ5	DBØ5	DBØ5	D5
D6	DBØ6	DBØ6	DBØ6	DBØ6	DBØ6	10	DBØ7	DBØ7	DBØ7	DBØ7	DBØ7	D7
NC	NC	$\overline{\text{HALT}}$	NC	NC	CONT 1)	11	NENIN	DD (OSI)	$\overline{\text{BUSRQ}}$	NC	$\overline{\text{TEST}}$	NC
NMI	NC	$\overline{\text{NMI}}$	$\overline{\text{NMI}}$	NMI	SA	12	SB	$\overline{\text{IRQ}}$	$\overline{\text{INT}}$	$\overline{\text{IRQ}}$	$\overline{\text{INT}}$	IRQ
NC	$\overline{\text{IN}}$	NC	NC/BB2,4 4)	NC	SIN 1)	13	SOUT 1)	NC	NC	NC	$\overline{\text{OUT}}$	NC
SO	NC	NC	NC	SO	FØ	14	F1	K7	NC	NC	NC	NC
NC	NC	NC	NC	K6	F2	15	Ø4ØØ-Ø5FF 2)	K5	NC	NC	NC	NC
⊥	⊥	⊥	⊥	⊥	⊥	16	⊥	⊥	⊥	⊥	⊥	NC
NC	NC	+12 V	+12 V	+12 V	+12 V/NC	17	NC 2)	K4	NC	BS 2)3)	NC	NC
NC	NC	BA	$\overline{\text{BUSAK}}$	K3	NENOUT	18	NC/−5 V	−5 V	−5 V	−5 V	(−5 V)	(−5 V)
A14	AD14	AD14	AD14	AD14	AD14	19	AD15	AD15	AD15	AD15	AD15	A15
A12	AD12	AD12	AD12	AD12	AD12	20	AD13	AD13	AD13	AD13	AD13	A13
A1Ø	AD1Ø	AD1Ø	AD1Ø	AD1Ø	AD1Ø	21	AD11	AD11	AD11	AD11	AD11	A11
A8	ADØ8	ADØ8	ADØ8	ADØ8	ADØ8	22	ADØ9	ADØ9	ADØ9	ADØ9	ADØ9	A9
A6	ADØ6	ADØ6	ADØ6	ADØ6	ADØ6	23	ADØ7	ADØ7	ADØ7	ADØ7	ADØ7	A7
A4	ADØ4	ADØ4	ADØ4	ADØ4	ADØ4	24	ADØ5	ADØ5	ADØ5	ADØ5	ADØ5	A5
A2	ADØ2	ADØ2	ADØ2	ADØ2	ADØ2	25	ADØ3	ADØ3	ADØ3	ADØ3	ADØ3	A3
AØ	ADØØ	ADØØ	ADØØ	ADØØ	ADØØ	26	ADØ1	ADØ1	ADØ1	ADØ1	ADØ1	A1
NC	$\overline{\text{NC}}$	$\overline{\text{E}}$	$\overline{\text{MREQ}}$	NC	NWDS+NRDS	27	X1	Φ2	PHIEX	E	(Φ)	Φ2
NC	$\overline{\text{RAS}}$	NC	RAS	K2	ØAØØ-ØBFF 1)	28	−7/+5 V	NC	NC	NC	NC	NC
R/$\overline{\text{W}}$	NC	NC	$\overline{\text{M1}}$	R/$\overline{\text{W}}$	$\overline{\text{CE}}$ RAM	29	ØCØØ-ØDFF 1)	K1	NC	NC	$\overline{\text{INTAK}}$	NC
NC	$\overline{\text{NC}}$	$\overline{\text{NC}}$	$\overline{\text{IORQ}}$	EX	CARDEN	30	NADS 1)	Φ1	$\overline{\text{RFRSH}}$	Q	NC	SYNC
NRDS	$\overline{\text{RD}}$	$\overline{\text{E · R/W}}$	$\overline{\text{RD}}$	NC	NRDS	31	NWDS	RAM-R/$\overline{\text{W}}$	$\overline{\text{WR}}$	R/$\overline{\text{W}}$	$\overline{\text{WR}}$	NWDS
⊥	⊥	⊥	⊥	⊥	⊥	32	⊥	⊥	⊥	⊥	⊥	⊥

Notes:
)1 not used by INS 8070
)2 15a reserved for A17
17a reserved for A16
)3 subject to change
)4 BB 2.4 = battery back-up + 2.4 V
These pin designations are the universally accepted standards (taking note 3 into account, of course).

83135

1

64-way connector	TRS-80 signals			TRS-80 signals	64-way connector
5a	SYSRES*	2	1	RAS*	28c
21c	A10	4	3	NC[1]	NC
20a	A13	6	5	A12	20c
32a, c	GND	8	7	A15	19a
19c	A14	10	9	A11	21a
13a	OUT*	12	11	A8	22c
29a	INTAK*	14	13	WR*	31a
NC	NC	16	15	RD*	31c
9c	D4	18	17	A9	22a
10a	D7	20	19	IN*	13c
7a	D1	22	21	INT*	12a
10c	D6	24	23	TEST*	11a
8a	D3	26	25	AØ	26c
9a	D5	28	27	A1	26a
7c	DØ	30	29	GND	4a,c/16a,c
8c	D2	32	31	A4	24c
25a	A3	34	33	WAIT*	5c
23a	A7	36	35	A5	24a
23c	A6	38	37	GND	4a,c/16a,c
25c	A2	40	39	+5 V	1a, c

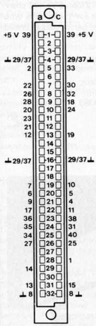
Note:
* indicates negative logic (an input or output is 'true' at the low logic level)
[1] CAS for the LNW80

83135-1

Figure 1. These are the signals available at the TRS-80 keyboard output connector. The LNW80 has an extra signal, CAS, at pin 3.

Figure 2. This shows an example of how the bus extension can be adapted for a TRS-80. Some of the a and c pins are connected together in this design to reduce resistance in the power supply lines (earth, +5 V and −12 V).

2 seen from above



83135-2

Table 1. Here we list the relation between the pins of a 64-way connector and the signals available on some microprocessor or microcomputer buses.

each circuit is more sophisticated than the next. The very sight of them is enough to bring out the 'experimenter' in every one of us. To make proper experimentation feasible, what is really needed is a bus board, which has several connectors to accept one or a number of cards, and preferably with its own on-board supply.

What is a bus?

Obviously everybody could design their own bus, to suit their own particular needs, but this would almost certainly rule out the possibility of borrowing a circuit from somebody else with a similar computer.
This is why Elektor designed a bus board in mid 1978 for the first microprocessor to appear in any of our circuits, the SC/MP. Gradually, as new micros started to appear (the 6502, Z80 and 6809), the number of lines needed began to increase. Originally the bus was intended only for one computer, the SC/MP. Eventually the Junior Computer arrived and the bus was used for this also. As the TRS-80 is still a very popular micro we decided that some rationalization was in order to make it compatible with the Elektor bus. The same applies for several other computers and the most recent addition to our list is the Acorn Atom.
What we have in mind is more than simply a modified and renewed bus. Since its inception, about five years ago, many micro computer buffs have used the Elektor bus for their computer system, whether that is Elektor's SC/MP or Junior Computer or something completely different. The layout suggested here has the advantage that it allows almost all the cards published by Elektor to be used without any modification; cards published elsewhere will also fit the format defined by the bus. Some of our cards have proved very popular, among them the universal memory card, the EPROM programmer and the floppy disk interface. Depending on what microprocessor the system is based on, the various cards can be used either without modification (6502), or with a certain number of modifications for some of them (Z80). Most of the Elektor cards can very easily be adapted to almost any system. Table 1 is a summary of the conventions used by various systems.

Applications

This extension can be used with any personal computer (possibly with some modification with some of those we have not mentioned), but it is *absolutely imperative* that the output bus of the computer is buffered (with a 74LS367 in the case of the TRS-80 model I).
It would be impossible to try to list all the possible circuits that could be plugged into the connectors of this bus extension. Some of the more interesting are: a speech synthesizer (SC01), sound synthesizer (1 . . . 3 AY-5-8910), EPROM programmer, all sorts of converters, real-time clock, circuit emulator. Often these various circuits have a large current consumption so it is a good idea to give the bus extension its own supply so that it can cope with these power-hungry cards. Circumstances dictate the characteristics of the supply (+ and −5 V, + and −12 V).
If such a supply is added only the earth line should be connected to the computer because the voltages supplied by the regulators will probably be slightly different and this could cause problems.
Nothing is more descriptive than an example, and we chose the TRS-80 as our guinea-pig. The signals available at the TRS-80 keyboard output connector are given in figure 1. The corresponding connections on the bus extension are illustrated in the drawing of figure 2.
Using this example you should be able to adapt this extension to any computer with a buffered output bus.
The simplest way of making this bus extension is to use a suitable printed circuit board, either the one described in the article 'new bus board for microprocessors' (January 1980, page 1-31), or the one described elsewhere in this issue. In the first case up to five connectors can be used, in the second this goes up to seven. In either case it is important that the components should be carefully located on the plug-in cards, to ensure that they can all be fitted. ◾

market

Temperature controlled soldering station

In new SA-3 series temperature controlled solder station from OK Industries is ideal for all soldering applications. Tip mounted sensors and sophisticated control circuitry ensure fast response and excellent stability within 5% over 100-500°C.
Furthermore the mains powered unit comes with a special 24 V 48 W low-leakage iron and is earthed for MOS and CMOS applications.

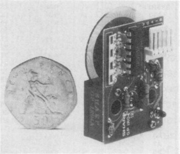
Ease of use is a feature and the tool has power and heater indicators, proportional temperature control and a temperature indicator. A variety of tips is offered. A solder spool holder, to accept any size of solder spools up to 7 in (178 mm) diameter is also available.

OK Industries UK Ltd,
Dutton Lane,
Eastleigh,
Hants, S05 4AA.
Telephone: 0703 610944

(2772 M)

Compact rotary encoder

Hero Electronics is now stocking the Sharp range of incremental rotary encoders and slotted discs.
The GP-1R04 series which is shown in the photograph is a photointerruptor type of rotary encoder with a built in light level compensating circuit consisting primarily of an infra red light emitting diode and integrated type photodiode. Other encoders include the GP-152 (rotary shaft encoder) and the GP-1R11 a smaller version of the GP-1R04.
The GP-1R04 provides 3 types of output 2-phase output — A — (approximate sine wave), — B — (approximate cosine wave) and — Z — Index output. The GP-1R04 series comprises 5 models with different slotted discs. Their resolutions are 96, 100, 192, 200 and 360 pulses per revolution.
The features of these encoders besides their compact and lightweight design are high accuracy in phase difference due to laser trimming, high frequency response because of the use of a laser diode and very good thermal characteristics. The encoders are excellent for detecting arc



angles the number of revolutions, rotational speeds and directions.
Application are in typewriters and printers, copiers, machine tools, robotics and in various types of measuring instruments, micrometers, venier calipers etc.

Hero Electronics Limited,
Dunstable Street,
Ampthill,
Bedfordshire, MK45 2JS.
Telephone: 0525 405015

(2771 M)

The Zicon 701 logic analyser

The Zicon 701 is a new 40 channel logic analyser from Zicon Instruments Ltd of Norwich.
Designed for use with 8-bit and 16-bit microprocessors, its 4 clock inputs permit full analysis of multiclock and multiplexed µP'S (such as the Z80 and 8085), to which it can be connected directly without personality probes. Its ability to de-multiplex makes possible the simultaneous display of address, data and status information. It records 1000 bits per channel at speeds up to 10 MHz, using a separate monitor or TV set as a display.
A succession of fully interactive menus, with a flashing cursor to indicate the relevant input field, makes setting-up quick and trouble-free. Invalid data entry is blocked, and messages on screen identify the errors.

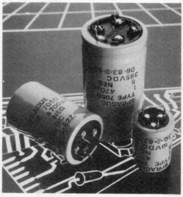
The trigger and trace capabilities of the Zicon 701 result in very flexible and precise data capture. Triggering is via a 24-bit trigger word with separate trigger qualifier and trigger count of 1 to 999 events. The clock qualifier includes a 24-bit trace facility which filters and selectively captures significant information. A delay feature allows the last trigger event to be positioned anywhere in the 1000 line memory to give a complete pre- and post-trigger analysis.
The data can be examined either (a) 'on screen' in normal listing format or as data signatures, or (b) as hard copy printout using the RS 232C output which is fitted as standard. Transmission speeds are selectable between 300 and 4800 baud.
Data listing offers a choice of six different formats of hex and/or binary code, with either 11 or 22 displayed lines depending on the format selected. The instrument accepts a full-width 40-bit search word, and both trigger words and search words are highlighted. Scrolling by line, page, trigger word or search word greatly facilitates data location.
The instrument is compact, light (5lbs) and portable, and thus ideally suited to field servicing and bench work alike. It is 100% British in design and manufacture.
Zicon Instruments Ltd were established in 1978 as a company specializing in the design and manufacture of logic analysers. Two of their earlier models, the Zicon 620 (8 channel) and the Zicon 632 (16 channel) are still available for those users who are looking for high performance linked to low cost.

Zicon Instruments Ltd.,
23 Meteor Close,
Airport Industrial Estate,
Norwich NR6 6HQ.
Telephone: 0603 400083

(2774 M)

PCB terminal multipin capacitor

Axiom electronics limited, who already carry in-depth stocks of Sprague type 705D aluminium electrolytic capacitors, have added a multipin pcb terminal version of the device to their inventory.

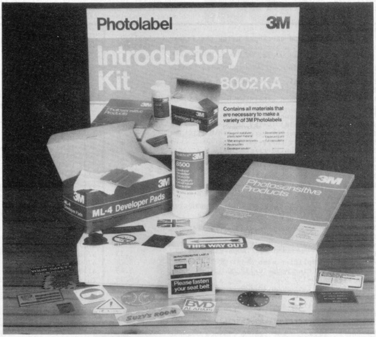


In common with the other components in the range, the multipin terminal capacitor features high ripple current, low ESR, and good high frequency characteristics, and has the additional advantage of mounting straight onto the printed circuit board.
The number of pins varies between three and five, depending on the diameter of the capacitor, to give total stability. The 705D multipin configuration conforms to DIN specification.
Sprague type 705D capacitors are equivalent to the Mullard 050 series. Exceptionally stable, they are ideal for use in switch mode power supplies, instrumentation, and telecommunications equipment.

Axiom Electronics Limited,
Turnpike Road,
Cressex Estate,
High Wycombe,
Bucks HP12 3NR.
Telephone: High Wycombe 442181

(2807 M)

Photolabel introductory kit



The new 3M photolabel introductory kit from the company's industrial marking systems group allows anyone to produce brightly coloured, self-adhesive metal and plastic labels in minutes — at a fraction of the cost of having them factory-made or printed.
The kit is an ideal introduction for a company or original equipement manufacturer wanting to make its own durable, professional looking labels, signs or markings for application to a smooth surface. The only other additional item required for their production is an ultraviolet light source.
The kit's contents include 13 sheets of photolabel material in assorted colours, matt and gloss laminating film, reversal film, developer solution and pads, an exposure guide and full instructions.
The light-sensitive emulsions are coated onto four types of base — heavy or standard guage aluminium, and transparent or coloured polyester. The range of base and colour combinations, which include red on aluminium, black on yellow, blue on clear plastic and black on white plastic, create smart, bright labels or signs for every use.
With the kit it can take a mere five minutes to make a Photolabel — at around 4 pence per square inch.

How it works

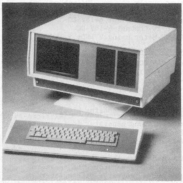
The original artwork, which should either be a negative or a drawing on tracing paper, is placed onto the emulsion side of the selected sheet of Photolabel material, and both are then exposed to ultraviolet light. Next, the sheet of material is processed by rubbing it gently with a pad soaked in 3M developer. This entire process may be carried out in daylight — no darkroom is required.
Additional protection from damage may be given to the label by either laminating it with 3M gloss or matt laminating film. With the Photolabel's reverse side being coated with a pressure sensitive adhesive, the completed label may be positioned on any rigid surface by simple peeling off the backing paper and pressing it into place. The new Kit permits the user to custom-make a wide range of attractive labels. Typical applications include logos, nameplates, prototype panels, wiring diagrams, charts, dial faces, control panels, electrical boxes, switching information, safety instructions, warning signs, art layouts, and a host of other labelling/signing projects.

Industrial Marking Systems Group,
3M United Kingdom PLC,
3M House,
P.O. Box 1,
Bracknell,
Berkshire RG12 1JU.
Telephone: 0344 58457

(2803 M)

19" terminal cases

New to OK Industries' Elrack enclosure series of enclosures, a range of 19in terminal cases has been designed for industrial, electronic, communications engineering and equipment monitor applications.



The design is modular, utilising six different kits to enable virtually any requirement to be met. Moulded from tough ABS the components include cases, extension kits, with ventilated side panels, keyboards and keyboard/displays. Components can be supplied either complete or in kit form for easy assembly.
Additionally the cases are available with front panels to accept switches or instrumentation, front panel heights being 223.5, 312.5, 402 or 490.5 mm. The standard colour is beige but other colours are available on request.

OK Industries UK Ltd.,
Dutton Lane,
Eastleigh,
Hants S05 4AA.
Telephone: 0703 610944

(2801 M)

T.V. SOUND TUNER BUILT AND TESTED

In the cut-throat world of consumer electronics, one of the questions designers apparently ponder over is "Will anyone notice if we save money by chopping this out?" In the domestic TV set, one of the first casualties seems to be the sound quality. Small speakers and no tone controls are common and all this is really quite sad, as the TV companies do their best to transmit the highest quality sound. Given this background a compact and independent TV tuner that connects direct to your Hi-Fi is a must for quality reproduction. The unit is mains operated.
This TV SOUND TUNER offers full UHF coverage with 5 pre-selected tuning controls. It can also be used in conjunction with your video recorder. Dimensions: 11¾" x 8½" x 3¼".

£24·95 + £2.00 p&p.

E.T.I. kit version of above without chassis, case and hardware. **£12.95** plus £1.50 p&p.

PRACTICAL ELECTRONICS STEREO CASSETTE RECORDER KIT

£32.95 + £2.75 p&p.

- NOISE REDUCTION SYSTEM • AUTO STOP • TAPE COUNTER • SWITCHABLE E.Q. • INDEPENDENT LEVEL CONTROLS • TWIN V.U. METER • WOW & FLUTTER 0.1% • RECORD/PLAYBACK I.C. WITH ELECTRONIC SWITCHING • FULLY VARIABLE RECORDING BIAS FOR ACCURATE MATCHING OF ALL TAPES.

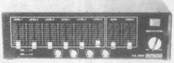
Kit includes tape transport mechanism, ready punched and back printed quality circuit board and all electronic parts, i.e. semiconductors, resistors capacitors, hardware top cover, printed scale and mains transformer. You only supply solder and hook-up wire.
Featured in April issue P.E. Reprint 50p. Free with kit.
Self assembly simulated wood sleeve – £4.50 + £1.50 p&p.

SPECIAL OFFER! £31.00 plus £2.75 p&p Complete with case.

MONO MIXER AMP

Ideal for Church halls & Club houses. **£45.00** + £2.00 p&p.

50 WATT Six individually mixed inputs for two pick ups (Cer. or mag.), two moving coil microphones and two auxiliary for tape tuner, organs, etc. Eight slider controls - six for level and two for master bass and treble, four extra treble controls for mic. and aux. inputs. Size: 13¼"x6½"x3¾" app. Power output 50 watts R.M.S. (cont.) for use with 4 to 8 ohm speakers. Attractive black vinyl case with matching fascia and knobs. Ready to use.



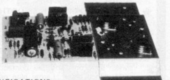
Matching AKG Microphone to suit (with speech and music filter). Complete with lead. **ONLY £9.95** plus 75p p&p.

125W HIGH POWER AMP MODULES

KIT **£10.50** + £1.15 p&p BUILT **£14.25** + £1.15 p&p

The power amp kit is a module for high power applications - disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC board is back printed, etched and ready to drill for ease of construction and the aluminium chassis is preformed and ready to use.
Supplied with all parts, circuit diagrams and instructions.

ACCESSORY: Stereo/mono mains power supply kit with transformer. **£10.50** plus £2.00 p&p.



SPECIFICATIONS:
Max. output power (RMS): 125W.
Operating voltage (DC): 50 - 80 max.
Loads: 4 - 16 ohms.
Frequency response measured @ 100 watts: 25Hz - 20KHz.
Sensitivity for 100 watts: 400mV @ 47K.
Typical T.H.D. @ 50 watts, 4 ohms: 0.1%.
Dimensions: 205 x 90 and 190 x 36 mm.

VHF STEREO TUNER KIT

• **SPECIAL OFFER!** •
£13.95 Plus £2.50 p&p.

This easy to build 3 band stereo AM/FM tuner kit is designed in conjunction with Practical Electronics (July '81 issue). For ease of construction and alignment it incorporates three Mullard modules and an I.C. IF. System.
FEATURES: VHF, MW, LW Bands, interstation muting and AFC on VHF. Tuning meter. Two back printed PCB's. Ready made chassis and scale. Aerial: AM - ferrite rod, FM - 75 or 300 ohms. Stabalised power supply with 'C' core mains transformer. All components supplied are to strict P.E. specification, Front scale size: 10½" x 2½" approx. Complete with diagram and instructions.

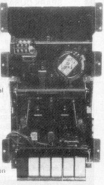
STEREO CASSETTE DECK

Stereo cassette tape deck transport with electronics. Manufacturer's surplus
– brand new and operational
– sold without warranty.

£11.95 plus £2.50 p&p.

Just requires mains transformer and input/output sockets and a volume control to complete.

Supplied with full connection details.



STEREO CARTRIDGES

PHILIPS
Magnetic cartridge with diamond stylus. Model No. GP-397 III. Output 2mV. Separation 22dB. Stylus 0.6mm diameter. **£3.95 each** plus 60p P&P.

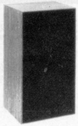
GARRARD
Sonotone Garrard Ceramic cartridge. 75mV. With turnover Sapphire stylus. **£2.95** plus 60p p&p.

HI-FI TWEETER BARGAIN

GOODMANS TWEETERS
8 ohm soft dome radiator tweeter (3¾"sq.) for use in up to 40W systems; with 2 element crossover.
£3.95 each (p&p £1) or
£6.95 pair (p&p £1.50)

SPEAKER KIT 2 WAY 10 WATT

8" bass/mid range and 3¼" tweeter. Complete with screws, wire, crossover components and cabinet. Cabinet comes in flat pre-mitred D.I.Y. form. Finish - chipboard covered wood simulate, size 14½"x 8¾"x 4". PAIR for ONLY
£12.50 plus £1.75 p&p.



AUDAX 8" SPEAKER

HIGH QUALITY 40 WATTS RMS BASS/MIDRANGE

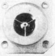
Ideal for either Hi-Fi or Disco use this speaker features an aluminium voice coil a heavy 70 mm diameter magnet.
Frequency res: 20Hz to 7KHz.
Impedance: 8 ohms.

£5.95 +£2.20 p&p

AUDAX 40W FERRO-FLUID HI-FI TWEETER

X/over on 5kHz 22kHz. 60mm square. 8 ohm.

£5.50 +60p p&p



All mail to:
21K HIGH STREET, ACTON W3 6NG.
Note: Goods despatched to U.K. postal addresses only. All items subject to availability. Prices correct at 30/9/83 and subject to change without notice. Please allow 14 working days from receipt of order for despatch. RTVC Limited reserve the right to update their products without notice. **All enquiries send S.A.E.**

ALL CALLERS TO: 323 EDGWARE ROAD, LONDON W2. **Telephone: 01-723 8432.**
(5 minutes walk from Edgware Road Tube Station)
Now open 6 days a week 9 – 6. Prices include VAT.

Telephone or mail orders by ACCESS welcome.

RTVC

spotlight on Elektor books

RESI & TRANSI

A series of strip cartoons in book form in which two enterprising characters explore the field of electronics in their own inimitable way. Their adventures are full of tension, because they often go against the current – whereby they encounter much resistance – before they reach their goal. These books familiarize the reader with electronics in an unusual way: exciting, playful, yet thorough. Part I comes complete with a printed-circuit board and resimeter.

Part I: Banish the Mysteries of Electronics . . . . £ 5.75
Part II: Hands off my Bike! . . . £ 4.50

TV GAMES COMPUTER

This book, provides a different – and, in many ways, easier – approach to microprocessors. The TV games computer is dedicated to one specific task, as the name suggests. This provides an almost unique opportunity to have fun while learning!

Price . . . . £ 6.75

DIGIBOOK

Provides a simple step-by-step introduction to the basic theory and application of digital electronics and gives clear explanations of the fundamentals of digital circuitry, backed up by experiments designed to reinforce this newly acquired knowledge. Supplied with an experimenter's PCB.

Price . . . . £ 6.00

300 CIRCUITS

For the home constructor – 300 projects ranging from the basic to the very sophisticated.

Price . . . . £ 5.50

MICROPROCESSOR HARDWARE

This book describes a range of peripheral equipment that can be connected and used with an assortment of personal computers which use the 6502, 6809, Z80 or the 8080 CPU.

Price . . . . £ 7.50

JUNIOR PAPERWARE 1

Modifications of the PM/PME EPROM: Source listings, Hex dump of the Software cruncher and puncher (Elektor 85, May 1982)

Price . . . . £ 2.00

JUNIOR PAPERWARE 2

Source listing of the bootstrap loader for Ohio Scientific Floppys: Hex dump of the EPROM (ESS 515)

Price . . . . £ 2.00

DATA SHEET BOOK

Here at last is the book that designers have been waiting for: the Elektor Data Sheet Book. In 240 pages it gives you a CMOS, a Linear, Special Function and Audio Data Book: extensive information on 269 of the most important IC's. A very useful and economical reference book!

Price . . . . £ 8.00

JUNIOR COMPUTER VIA 6522

This book deals with the well-known Versatile Interface Adapter (VIA) type 6522. Although it is an indispensable addition to the four books already devoted to the Junior Computer, it is not aimed solely at Junior users, but at anybody who has a system with one or more 6522s. It affords a complete familiarization with this flexible and effective component.

Price . . . . £ 3.25

JUNIOR COMPUTER BOOK 1

For anyone wishing to become familiar with (micro)computers, this book gives the opportunity to build and program a personal computer at a very reasonable cost.

Price . . . . £ 6.50

JUNIOR COMPUTER BOOK 2

Follows in a logical continuation of Book 1, and contains a detailed appraisal of the software. Three major programming tools, the monitor, an assembler and an editor, are discussed together with practical proposals for input and peripherals.

Price . . . . £ 6.50

JUNIOR COMPUTER BOOK 3

The next, transforming the basic, single-board Junior Computer into a complete personal computer system.

Price . . . . £ 6.50

JUNIOR COMPUTER BOOK 4

Book 4, the last in the series, describes all the software required to operate the complete system. A number of peripheral devices, such as a printer and a video terminal, may be 'hooked up' to the computer. During the final stage in its 'growth', the machine is able to extend its linguistic skills, for a special version of BASIC is now available on cassette.

Price . . . . £ 6.50

301 CIRCUITS

The book is a continuation of our popular and very successful 300 circuits publication. It is composed of 301 assorted circuits ranging from simple to more complex designs, described and explained in straightforward language.

Price . . . . £ 5.50

SC/MPUTER (1)

Describes how to build and operate your own microprocessor system – the first book of a series – further books will show how the system may be extended to meet various requirements.

Price . . . . £ 5.50

SC/MPUTER (2)

The second book in series. An updated version of the monitor program (Elbug II) is introduced together with a number of expansion possibilities. By adding the Elekterminal to the system described in Book 1 the microcomputer becomes even more versatile.

Price . . . . £ 5.50

FORMANT

Complete constructional details of the Elektor Formant Synthesiser – comes with a FREE cassette of sounds that the Formant is capable of producing together with advice on how to achieve them.

Price . . . . £ 6.00

33 ELECTRONIC GAMES

A selection of circuits which give as much enjoyment in building them as actually playing the games. The circuits are fascinating although the electronics involved are not complex and therefore anyone with a good soldering iron will find this book satisfying. These are electronic games that do not need a TV screen, and as a result can be played just about anywhere.

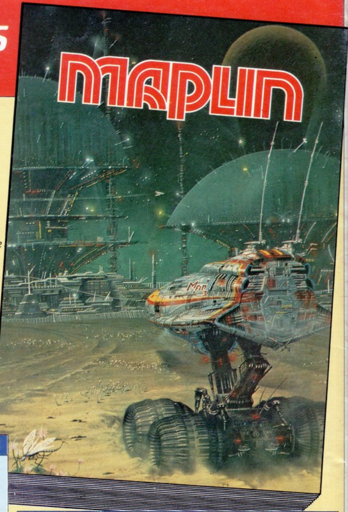
Price . . . . £ 4.50

To order please use the postage paid order card in this issue.
ADD 50p P & P U.K. (OVERSEAS £ 1.00)

AIR-MAIL COPY

THE NEW MAPLIN CATALOGUE FOR 84!

NOW WITH PRICES ON THE PAGE



More data, more circuits, more pictures, in the brand new 480 page Maplin catalogue. Take a look at the completely revised Semiconductor section or the new Heathkit section with descriptions and pictures of dozens of kits and educational products from digital clocks to 16-bit business computers. The much expanded computer section itself, gives details of hundreds of pieces of software for Atari, BBC, Commodore 64, Dragon, Spectrum and VIC20. In addition to all this you'll find hundreds of fascinating new items spread through the rest of the catalogue.

As always, the Maplin catalogue is tremendous value for money and now has prices on the page!

Pick up a copy at any branch of W.H.Smith or in one of our shops for just £1.35 or send £1.65 including postage to our Rayleigh address. On sale from 1st Nov 1983.

PROJECTS FOR THE HOME CONSTRUCTOR

Choose from our huge range of value-for-money projects. Projects like our Modem, Mosfet Stereo Amplifier, Home Security System, Frequency Counter and Home Computer add-on kits. Full construction details in our Project Books and brief specifications in our new catalogue. Dozens of fascinating new projects coming soon including a Keyboard for the ZX Spectrum with electronics to make all shifts, single-key operations. Full details in Project Book 9 on sale 11th November 1983. Order As XA09K. Price 70p.

NEW MAPLIN STORE IN SOUTHAMPTON

Opening on 1st November 1983, our new south coast store is at 46–48 Bevois Valley Road, Southampton (Tel: 0703 25831). You will find our full range of components, projects and computers on sale. We are within easy reach of the city centre with good parking close by. Call in and see us soon.

Post this coupon now for your copy of the 1984 catalogue. Price £1.35 + 30p post and packing. If you live outside the U.K. send £2.20 or 11 International Reply Coupons. I enclose £1.65.

Name ....

Address..

....

.... E12/83

MAPLIN ELECTRONIC SUPPLIES LTD

Mail Order: P.O. Box 3, Rayleigh, Essex SS6 8LR. Tel: Southend (0702) 552911 ● Shops at: 159–161 King Street, Hammersmith, London W6. Tel: 01–748–0926 ● 8 Oxford Road, Manchester. Tel: 061–236–0281 ● Lynton Square, Perry Barr, Birmingham. Tel: 021–356–7292 ● 282–284 London Road, Westcliff–on–Sea Essex. Tel: 0702 554000 ● *46–48 Bevois Valley Road, Southampton. Tel: 0703 25831.
Opens 1st November 1983.** ***All shops closed Mondays.
All prices include VAT and carriage. Please add 50p handling charge to orders under £5 total value (except catalogue).